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TREATMENT OF MASS CIVILIAN CASUALTIES

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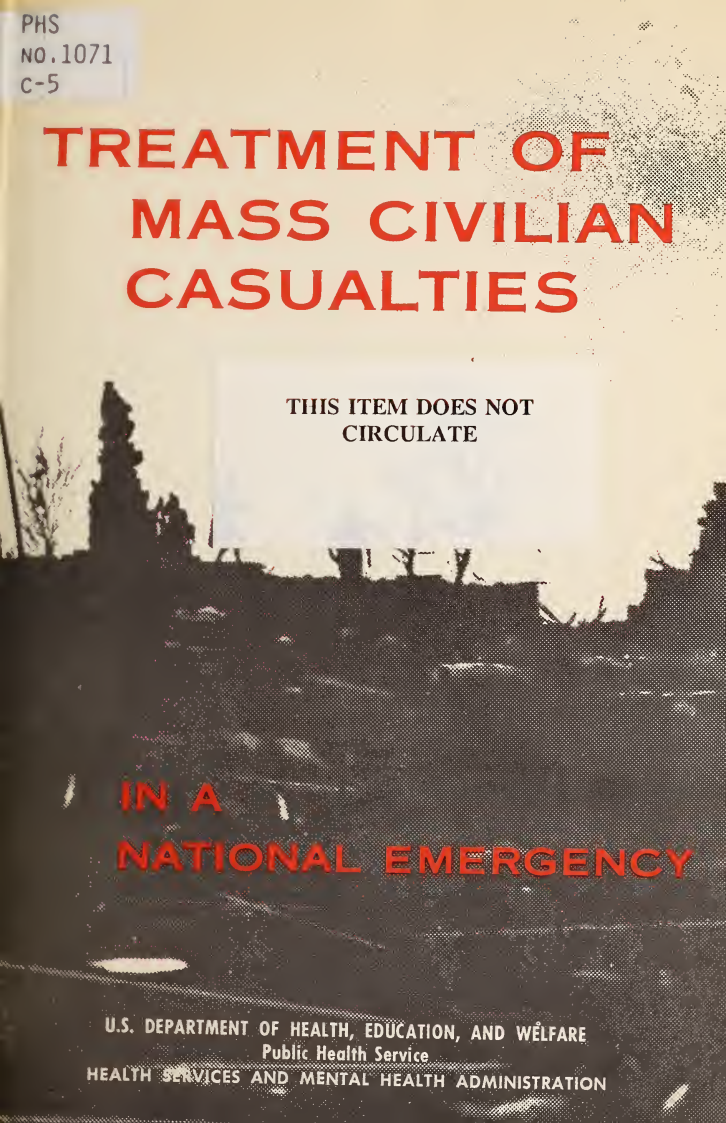

IN A NATIONAL EMERGENCY

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
HEALTH SERVICES AND MENTAL HEALTH ADMINISTRATION

Emergency Health Services Series C–5

THE TREATMENT OF MASS CIVILIAN CASUALTIES IN A NATIONAL EMERGENCY

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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Health Services and Mental Health Administration
Division of Emergency Health Services

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THE TREATMENT OF MASS CIVILIAN CASUALTIES IN A NATIONAL EMERGENCY

An outline of simplified procedures for the management of mass casualties in a temporary or permanent functioning hospital

This manual was prepared by the Trauma Research Group of Cornell University Medical College for the Division of Health Mobilization of the United States Public Health Service under contract SAph 73885. The clinical procedures outlined were developed with the active assistance of the Committee on Trauma of the American College of Surgeons, and the Committee on Trauma endorses the principles it contains.

[The Division of Health Mobilization became the Division of Emergency Health Services in November 1968]

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Special thanks are due to the following consultants who contributed generously of their time and skills in the preparation and review of individual sections.

Shock	Fraser Gurd, M. D.
	John Howard, M. D.
Burns	Truman Blocker, M. D.
	Curtis Artz, M. D.
Open Wounds	Preston Wade, M. D.
	Oscar P. Hampton, M. D.
Head Injuries	Edward Schlesinger, M. D.
	Frank Mayfield, M. D.
Thoracic Injuries	Cranston Holman, M. D.
	Robert H. Wylie, M. D.
Abdominal Injuries	Robert H. Kennedy, M. D.
	William L. Estes, M. D.
Pelvic Injuries	Lazarus Orkin, M. D.
	Victor F. Marshall, M. D.
Extremity Injuries	Charles Neer, M. D.
	Oscar P. Hampton, M. D.
	Preston Wade, M. D.
Maxillofacial Injuries	James B. Brown, M. D.
	Herbert Conway, M. D.
Eye Injuries	Edward Dunlap, M. D.
Obstetric Problems	William Sweeney, M. D.
Psychiatric Problems	William Wainwright, M. D.
Infections	Walter Modell, M. D.
	Donald Kaye, M. D.
	Edward Hook, M. D.
General Medical Problems	Eric J. Cassell, M. D.
Radiation Injury	David Becker, M. D.
Anesthesia Problems	Benjamin Marbury, M. D.

James R. McCarroll, M. D.
Paul A. Skudder, M.D.
Editors

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INTRODUCTION

This guide outlines a series of procedures which can be used to treat large numbers of casualties under acute emergency conditions. It is designed for use only in those circumstances when natural catastrophe or wartime operations result in a much larger number of persons needing medical care than can be treated in a hospital with conventional treatment procedures. Under these austere circumstances modifications must be made in customary treatment procedures. This manual was originally prepared as an outline of the types of procedures which would be most appropriate and effective following a thermonuclear attack. The procedures outlined, however, may appropriately be used whenever a hospital is faced with an overwhelming number of accident victims so that normal standards of medical treatment cannot be applied.

The experience of hospitals providing emergency medical care to victims of all types of naturally occurring mass disasters has invariably indicated that without careful advance planning, medical personnel and facilities are never utilized in an optimum or appropriate manner. The procedures outlined in this manual should, therefore, be learned by all physicians who may be called upon to participate in the care of accident victims under emergency circumstances. Many of these procedures may also appropriately be taught to other allied health personnel such as dentists, veterinarians, nurses, laboratory technicians, etc. Under the extreme circumstances for which this manual is intended many types of activities and procedures may be assigned to persons not normally trained for such work. To provide the optimum medical care possible in these austere circumstances there would be a general upgrading of responsibility. Since surgical problems predominate in most mass disaster situations, many physicians normally practicing other specialties will be called upon to perform some surgical procedures. Other allied health personnel will also be assigned duties normally outside their fields of professional competence. Such upgrading and reassignment, however, can be effective only if the persons involved have been previously trained in the principles and procedures they are to carry out. To serve as a basis for such a

training program this manual outlines simplified and standardized treatment techniques for the principal medical and surgical problems which may be anticipated in times of mass disaster.

Certain assumptions based, in part, on experiences of physicians and hospitals in mass disaster situations have been made, and these must be kept in mind in evaluating any of the recommended treatment procedures. First, the assumption is made that the skills and training of a physician are best used when employed in the setting of a functioning hospital. This manual is not intended as an outline of first aid or emergency procedures to be applied at a disaster site. It is an outline of simplified and standardized procedures for as much definitive medical and surgical care possible, which can be applied simultaneously to a large number of accident victims in a hospital. In the event of a thermonuclear attack such functioning hospitals would obviously remain only outside of devastated areas. They would nevertheless have the responsibility for medical care of a large number of casualties from fringe areas who would be brought to the hospital for treatment.

A second premise on which these treatment procedures are based is the presence of a functioning physical plant with essential services including potable water supply, food, electricity, elevators (if required), housekeeping facilities, communications, and police protection. Nevertheless, many of these supplies and services will not be available in sufficient amounts to maintain normal standards of care for an overwhelming number of casualties. The treatment procedures outlined are, therefore, intended to make optimum use of available supplies and personnel for the benefit of the largest number of patients possible. Stockpiling of medical supplies at strategic locations throughout the country helps to assure their availability under emergency circumstances. Although the treatment procedures outlined have been simplified and standardized as much as possible, adequate supplies and equipment and medications to carry them out are also assumed. Transportation of these stockpiled supplies to hospitals is a responsibility of the local civil defense organization.

The goal of all persons providing medical care following a mass disaster such as a thermonuclear attack must be to restore the maximum number of productive persons to activity as rapidly as possible. To accomplish this, some revision of normally accepted treatment goals and standards is needed. SORTING patients into priority categories for treatment is the initial step in this process.

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II. SORTING

SORTING is the basic procedure in caring for large numbers of patients at one time. In Sorting, patients are placed in categories for priority of treatment. The basic objective of medical treatment in times of mass disaster must be to return the largest possible number of persons to productive activity as rapidly as possible. Persons receiving immediate medical care will, therefore, be those for whom a short period of treatment or a relatively simple procedure will significantly improve the prognosis. Severity of injury, per se, is not the determining factor in assigning treatment category. Some persons with serious injuries may be placed in the immediate treatment category if a relatively brief or simple procedure may alter an otherwise poor prognosis or avoid serious future disability. Patients with injuries, whether major or minor, whose treatment would demand considerable professional time must be placed in a delayed or expectant treatment category and receive only emergency or supportive care until sufficient personnel and facilities are available to render the more time-consuming definitive treatment.

In mass disaster situations speed and competence in Sorting is the single most important medical professional function. Since the two fundamental components of Sorting are diagnosis and prognosis this function should be assigned to the most experienced surgeon present. He may be assisted by other professional persons who will be able to classify many patients whose treatment categories can be easily determined.

The Sorting area should be located close to the principal entrance to the hospital so that all patients may be channeled through it. It is essential that some type of police, military, or other security protection be given to regulate the flow of pateints entering for Sorting, and to prevent unauthorized persons from entering the hospital. Each physician working in the Sorting area should be assited by one or more other persons who prepare the patient for examination and assist the Sorting physician. As the patient arrives in the Sorting area basic identification data including name, age, address, religion, name and address of person to be notified and date and time of admission

should be recorded. The patient should be prepared for examination by removal of sufficient clothing to allow inspection of the injured area by the Sorting officer. Unconscious patients should be completely undressed so that injuries covered by clothing will not be ignored. After examination by the Sorting physician, an assistant should record the treatment category, diagnosis, and any treatment or medication given at the time of Sorting on the patient's Emergency Medical Tag. This tag should then be attached securely to the body of the injured person, not to clothing or stretcher covering. Clothing should accompany the patient unless radioactive or otherwise unusable since clean uncontaminated clothing may be in short supply.

If radioactive contamination is a possibility, decontamination procedures should be carried out before the patient enters the Sorting area of the hospital. (For details, see the section on Radiation Injuries.)

Sorting assistants should be trained to carry out immediate life-saving procedures such as control of hemorrhage and maintenance of airway. Except for such emergency procedures, however, treatment should not be carried out in the Sorting area. Patients should be promptly removed after examination to the appropriate treatment area designated by the Sorting officer. Personnel must be available to carry or conduct patients to these treatment areas. These persons should not be the assistants in the Sorting area since Sorting assistants should remain with the Sorting officer at all times.

At Sorting, all patients are assigned to one of four treatment categories:

I. Ambulatory Treatment
II. Immediate Treatment
III. Delayed Treatment
IV. Expectant Treatment

The principal factor determining the category into which the patient is placed is not the severity of the injury as would be the case in customary peacetime medical practice, but in these emergency circumstances is the length of time needed to carry out treatment. It is important to remember, however, that Sorting is a continuous process to be repeated in all areas of the hospital so that patients are constantly being changed from one treatment category to another as justified by circumstances. Thus, patients

placed in the Delayed Treatment Category will be moved into the Immediate Treatment group as rapidly as personnel and facilities become available. Similarly patients receiving active treatment who are subsequently found to have conditions needing prolonged or intensive care may have to have this treatment delayed until more professional personnel become available.

Category I — Ambulatory Treatment

Immediate ambulatory treatment is given all patients who have injuries not needing immediate hospitalization and for which ambulatory care can be given. Under these austere circumstances many patients with injuries who would normally be hospitalized may be given immediate treatment and discharged to provide space for other casualties. As some persons in the Ambulatory Treatment Category complete their therapy, they may be asked to assist in either medical or housekeeping functions of the hospital. Persons not needed for these functions should be promptly discharged.

On discharge each person should be instructed in the management of his condition. A brief description of treatment rendered and instructions for follow-up care should be written on a portion of the patient's Emergency Medical Tag which he retains to present to the medical facility at which he receives follow-up medical care. All immunizations, antibiotics, narcotics, and sedatives administered and prescribed should be noted on this emergency tag. The patient should be told how soon further medical care will be needed and how to care for his injuries until that time. Whenever possible treatment prescribed for ambulatory patients should be that which they may carry out for themselves (self care) or have administered by a companion (buddy care).

Examples of conditions which can be handled on an ambulatory basis include third-degree burns of less than 15% of the body area, lacerations of soft tissue requiring only cleansing and dressing, and fractures of bones which permit ambulation and home care. Persons likely to have been exposed to radioactive contamination are also placed in this group since they have no immediate symptoms and no immediate therapy is possible. No treatment for radiation exposure other than standard decontamination is possible under these circumstances.

Category II — Immediate Treatment

The principal attention of all persons working in the hospital is given to care of patients placed in the Immediate Treatment category. This will include not only those persons with relatively minor injuries who cannot be treated on an ambulatory basis, but also persons with more severe injuries for which relatively simple or brief treatment procedures might prevent prolonged illness, disability, or death. Seriousness of injury is, therefore, not a determining factor in placing a patient in this category. Early return to productive activity or the avoiding of subsequent disability are the goals of treatment for patients in this category.

Examples of the types of injury which would usually be assigned to the Immediate Treatment category are hemorrhage from easily accessible areas, easily correctable respiratory defects, incomplete amputations of extremities, open fractures of major bones, uncomplicated major soft tissue wounds, and burns of 15% to 40% of the body area. In general patients with injuries which would not be aggravated by a delay in treatment would not be placed in this category.

Persons assigned to the Immediate Treatment category by the Sorting officer should be removed immediately to previously designated areas of the hospital where immediate treatment is being carried out. Several different areas of the hospital may be used for different types of immediate treatment. Thus, one area of the hospital may be designated as a "Shock Treatment Area," another as "Burn Treatment Area," and another as "Fracture Treatment Area," etc. This permits concentration of facilities and supplies for treatment of specific conditions where patients needing these modalities are grouped. Allied health personnel trained in specific procedures may also then be assigned to appropriate areas.

Sorting officers should be continuously informed of the number of patients currently being treated in each area since availability of space and facilities will, in part, determine the number of patients who can be assigned to the Immediate Treatment category. It should be emphasized again that Sorting is a continuous process with patients constantly being moved into the Immediate Treatment category from other groups as circumstances permit.

Category III — Delayed Treatment

Patients placed in the Delayed Treatment category are those with conditions for which treatment may be delayed without immediate jeopardy to life, or with conditions which demand time, equipment, and personnel in quantities not feasible under these austere circumstances. Patients placed in the Delayed Treatment category will include persons with minor injuries who cannot care for themselves outside the hospital but for whom a delay in treatment will not significantly alter the eventual outcome. Patients with more serious injuries placed in this category may be either those with conditions where some delay in treatment will have little effect on the final result or patients with serious or multiple injuries needing time-consuming intensive care. General supportive care will be given to persons placed in this treatment category as well as much stabilizing or definitive care as circumstances and availability of personnel permit. As personnel and facilities become available, patients will be constantly reassigned from the Delayed Treatment category to the Immediate Treatment category. Examples of the types of injuries which may have to be placed in the Delayed Treatment category in mass disaster circumstances include closed fractures of the legs, most severe eye injuries and fractures of the pelvis and spine.

In addition to disaster victims assigned to the Delayed Treatment category, the areas devoted to the care of these patients may also contain other patients who were under treatment in the hospital before the disaster occurred but who could not be discharged. As early as possible intensive sorting should be carried out for all these patients so that as many as possible may be discharged to make room for the disaster victims. A large number of the patients normally found in a general hospital may be discharged immediately under these austere conditions without prejudice to their medical problems. Some may be utilized as stretcher bearers, guides, police personnel, etc. Some may be assigned to the Immediate and Delayed Treatment areas to assist in caring for accident victims. Some may themselves be placed in the Delayed Treatment group to await more appropriate time for definitive therapy. The smallest number may have active treatment continued as a part of the Immediate Treatment group. (For details of reassignment

of these in-patients, see sections on General Medical Problems and Psychiatric Problems.)

Category IV – Expectant Treatment

In times of mass disaster when existing facilities are strained to care for an overwhelming patient load, it may be necessary to place some severely injured persons, or those whose prognosis is poor, in an Expectant Treatment category. These patients can receive nothing more than simple custodial care, although supervisory care should be available to keep patients as comfortable as possible and attend to basic body needs. Analgesics should be given freely to these patients and they should be kept as comfortable as circumstances permit. Some patients assigned to this category because of poor prognosis but who have few immediate symptoms such as those who have received large amounts of radiation may nevertheless be discharged from the hospital. Most patients assigned to this category, however, will be bedridden or unable to care for their severe and multiple injuries, and will require some type of supervision. Patients assigned to this category will include not only those with severe and multiple injuries which need time-consuming and intensive care, but will also include patients with less severe injuries in whom the presence of other illnesses or extreme age make the eventual outcome doubtful. Thus, the potential for future productive activity, or lack of it, must also be considered in selecting the appropriate treatment category. As the patient load decreases it may be possible to promote surviving patients from the Expectant Treatment category, but in general, the treatment of these patients must be given a low priority.

DIAGNOSIS OF SHOCK

Shock should always be suspected in a patient experiencing severe or multiple injuries. The principal signs of surgical shock are pale or cold clammy skin, apathy, restlessness or apprehension, weak peripheral pulse, low blood pressure and decreased urinary output. Laboratory tests are neither feasible nor necessary under austere circumstances in diagnosing shock. Blood pressure and the previously mentioned physical signs are the only feasible guides in evaluating the progress of the patient under treatment for shock. Patients in shock should be carefully examined for the presence of hidden injuries and concealed hemorrhage. In most cases treatment for shock will be ineffective unless the accompanying injury is also treated.

SORTING OF PATIENTS IN SHOCK

Patients in shock will be placed in either the Immediate or Delayed Treatment category depending on the nature of the accompanying injury. Patients placed in the Immediate Treatment category will receive active treatment for shock as outlined below as well as the appropriate treatment for accompanying injuries. Patients whose injuries require placement in the Delayed Treatment category but who are also in shock will, nevertheless, receive a modified treatment for shock as outlined below. In addition to the care of victims of the immediate disaster, hospitals will be expected to continue providing emergency care for a variety of other emergent conditions. The Sorting Officer must, therefore, consider the possibility of emergency conditions other than traumatic injuries such as cardiorenal disease, metabolic disease and various non-traumatic surgical conditions as a possible cause of shock in a patient without obvious injuries.

MANAGEMENT OF PATIENTS IN SHOCK

1. Ambulatory Treatment Category

No patients in shock will be assigned to the Ambulatory Treatment category.

2. Immediate Treatment Category

Patients in shock placed in the Immediate Treatment category will be given specific treatment for the traumatic injuries sustained as outlined in the appropriate section. In addition, intensive treatment for shock, as outlined below, will be started. All other patients placed in the Immediate Treatment category who are not in shock at the time of Sorting should be observed as closely as may be feasible for signs of impending shock, and immediate therapy should be instituted if signs of shock appear.

Bleeding from accessible areas should be controlled with pressure dressings. Tourniquets will rarely be necessary. Occasionally it may be necessary to clamp and ligate a vessel. The patient should be moved as little as possible. No sedatives or narcotics should be administered for shock alone. These medications should be given only if indicated by some other accompanying injury. The smallest possible amounts should be used since absorption from subcutaneous injections may be delayed until blood pressure is restored when the total amount may be absorbed at one time. If possible, all such medications should be given intravenously to patients in shock.

Most cases of shock under these circumstances will be due to blood loss from internal or external hemorrhage. Other cases of shock may be associated with severe burns with loss of body fluids from the burned areas. A few days after a mass disaster some cases of shock may be seen associated with overwhelming infection, vomiting or diarrhea. Treatment should, therefore, consist of control of hemorrhage and infection, and restoration of normal blood volume. Whole blood will rarely be available in adequate amounts to treat large numbers of casualties in a short period of time. Such dried plasma and plasma expanders as may be available should be reserved for patients who are receiving Immediate Treatment priority.

Most patients in shock must be treated with oral electrolyte solution prepared by adding one teaspoon of table salt ($NaCl$) to 1/2 teaspoon of bicarbonate of soda ($NaHCO_3$) to onequart of water. Two quarts of this solution provides the daily minimum fluid requirements for an adult. Patients in shock need additional electrolyte solution in amounts sufficient to restore and maintain normal blood pressure. Obviously patients who are unconscious, vomiting or have signs

of possible perforation of the gastrointestinal tract should not be given oral therapy. If intravenous feedings are not possible, it may be feasible to insert a nasogastric tube and administer the fluid through it.

The patient should be placed in a head-down position by elevating the foot of the stretcher or bed 6 to 8 inches. Normal body temperatures should be maintained by the use of coverings, if necessary, but the routine use of blankets at normal room temperature should be avoided.

In patients receiving intensive treatment for shock such as those being prepared for immediate surgery, insertion of an indwelling catheter is helpful. If urinary output is below 5 ml. per hour, or if it decreases as the blood pressure rises in response to fluid therapy, the patient is experiencing a renal shutdown. No intensive surgery should be considered for these patients and they should be transferred to the Delayed Treatment category until a urinary output of at least 500 ml. per day is achieved.

3. Delayed Treatment Category

Patients in shock placed in the Delayed Treatment category will nevertheless be given most of the therapy outlined above. No intravenous therapy of whole blood, plasma or plasma expanders will be used on these patients. Treatment will consist of control of obvious hemorrhage, intravenous administration of narcotics or sedatives if needed for associated injuries, maintenance of normal body temperatures and head-down position, and administration of oral electrolyte solution.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

All procedures for the treatment of shock outlined above may be carried out by members of any of the allied health professions after training. All persons assisting in the care of casualty victims should be taught to recognize the presence of shock. The allied health workers placed in charge of Delayed Treatment units should be especially alert to the development of shock in these patients, and should institute treatment as outlined above without waiting for consultation with a physician. All persons in allied health professions should be trained to take blood pressure measurements. Dentists, veterinarians, and nurses may

also be taught the techniques of active treatment of shock including control of hemorrhage and intravenous therapy.

EQUIPMENT NEEDED FOR THE TREATMENT OF SHOCK

1. Beds or stretchers — one per patient
2. Blankets or other coverings — one per patient
3. Blocks or boxes to elevate the foot of bed or stretcher — one per patient
4. Table salt (NaC1) 30 gms. per patient
5. Bicarbonate of soda ($NaHCO_3$) 15 gms. per patient
6. Water — 8 quarts per patient.

The amount of equipment needed for intravenous therapy for shock will depend on the available number of persons trained to carry out this therapy. If intravenous therapy could be carried out for all patients in the Immediate Treatment category, the following supplies should be available:

a. Intravenous infusion sets — 2 per patient
b. Five percent dextrose in water — 6 liters per patient
c. Five percent dextrose in saline or lactated Ringer's solution — 6 liters per patient
d. Plasma expander — 2 liters per patient
e. Serum albumin —59 gms. per patient
f. Blood collection bottles — 4 per patient receiving transfusion
g. Cross matching units and equipment to carry out blood compatability tests
h. Hypodermic needles — 15, 20 and 25 gauge — 3 of each per patient
i. Catheters, Foley 5 ml. plus bag, No. 20, No. 24 — 1 of each per patient.

IV. BURNS

DIAGNOSIS OF BURNS

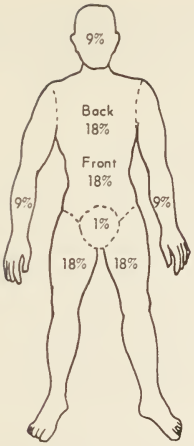
Burns are one of the most common injuries encountered in most mass disaster situations. Burns may be of first, second or third degree determined by the depth of tissue destruction. Frequently a combination of two or three types of burns is encountered in the same patient.

First degree burns, diagnosed by the presence of redness and pain need no treatment under austere conditions. Second degree burns, in addition to redness and pains, are accompanied by blister formation. Third degree burns may appear either pale or dark and leathery and may not be painful. Flash and hot water burns are usually of only first or second degree. Contact, flame, hot tar and oil, and electrical burns are usually third degree, or a combination of second and third degrees. Since the treatment category to which a burned patient is assigned depends on the extent of body area burned as well as the location of the burns, an estimate of the total body area burned must be made by the Sorting officer. To accomplish this the "rule of nines" is the simplest method and should be learned by all medical personnel. Under this system each section of the body is assigned an area percentage. Each arm is considered 9% of the total body area, each leg — 18%, the head — 9%, the back — 18%, and the chest and abdomen — 18%.

This system permits a simple, rapid assessment of the percentage of body area covered by burns. Only second and third degree burns are considered in evaluating the body area burned by the "rule of nines." First degree burns are ignored in the evaluation. Estimates rounded off to 5% (e.g., 25-30%) are satisfactory in managing large groups of patients.

SORTING OF BURNS

Treatment categories assigned to burn patients depend upon both the location and extent of the burned area. Some patients with only five percent body area burns may be unable to care for themselves if the lesions involve the hands, face, or feet.



Rule of Nines showing relative distribution of total body surface area.

1. Ambulatory Treatment Category

Most patients with only first degree burns should be placed in the Ambulatory Treatment category. No therapy is needed for most first degree burns but analgesics may be given if the burn is painful. Patients with second and third degree burns of less than 15% of body area should also be placed in the Ambulatory Treatment category unless the burn involves a body area such as the face, hands, feet or perineum, which makes self-care impossible.

2. Immediate Treatment Category

Patients with second and third degree burns of 15% to 40% of the body area will be placed in the Immediate Treatment category since salvage of many of these patients is possible.

3. Delayed Treatment Category

Patients with second and third degree burns of over 40% of the body area must be placed in the Delayed Treatment category since few of them will survive regardless of treatment.

In some disaster situations the arbitrary limits of 15% and 40% may have to be lowered since many persons with severe burns will also have other injuries which must be considered in assigning treatment category.

TREATMENT OF BURNS

1. Ambulatory Treatment Category

Except for severe hand, face and lower extremity burns, patients with less than 15% of the body area burned will be treated on an ambulatory basis. Treatment consists of thorough cleansing of second and third degree burns with soap and water. After cleansing, all burns except those of the face should be covered with sterile dressings. If insufficient sterile dressings are available clean dressings may be made from bed linens, towels, etc. The protective dressings are applied to prevent contamination from overlying clothing and should be applied lightly but securely and left in place for one week. Only burns of the face should be treated by exposure in ambulatory patients who will be discharged to self-care.

All patients with third degree burns treated on an ambulatory basis should be given oral tetracycline 250 mg. four times daily for seven days in an attempt to prevent infection. Prophylaxis against tetanus as outlined in the section on Open Wounds should also be given.

Oral electrolyte solution should also be given to patients with serious third degree burns. This may be provided in the form of self-care burn packets containing 3 gms. of table salt (NaC1) 1-1/2 gms. of bicarbonate of soda ($NaHCO_3$). Patients should be instructed to dissolve the salts in one quart of water to be swallowed over a 24-hour period. They should also be instructed to drink as much additional fluid as possible. The ambulatory patient with third degree burns should also be given a one-week supply of tetracycline capsules on discharge (250 mgm. four times daily for seven days). Preprinted instructions for electrolyte and antibiotic therapy should be given to discharged patients. He should be instructed to seek immediate treatment if vomiting, marked decrease in urine output, difficulty in breathing or facial swelling develops. Otherwide, he should be instructed to leave his burn dressings intact and to seek medical care in one week for redressing.

2. Immediate Treatment Category

Patients with 15% to 40% of the body area burned, as well as some patients with less extensive burns who cannot care for themselves will be given intensive hospital treatment. Burned areas should be gently cleansed with detergent or soap and water and washed with clean water. Burns should be covered with sterile multi-layer dressings. Rolls of six-inch gauze bandages facilitate applying these dressings rapidly. Burned areas should not be scrubbed or handled more than necessary. Dressings should be lightly applied. They are used in preference to the open method of treatment because of the possibility of contamination and infection under crowded conditions. Efforts to prevent cross contamination between patients with third degree burns should be observed whenever possible. Patients with serious third degree burns should be separated from others as far as possible and allied health personnel caring for these patients should be trained to observe sterile technique as much as possible.

Dressings should be left in place unchanged for seven days unless infection necessitates earlier changing. All patients with third degree burns should receive at least seven days of oral tetracycline therapy (250 mgm. four times daily). After approximately one week, burn patients in the Immediate Treatment category may be considered for surgical debridement and skin grafting if circumstances then permit such procedures.

All patients with severe burns receiving intensive therapy should be given fluids liberally. Patients able to tolerate oral feeding should be given electrolyte solution prepared by adding one teaspoon of table salt (NaCl) and 1/2 teaspoon of bicarbonate of soda ($NaHCO_3$) to one quart of water. A simple guide to the amount of fluid needed is to give 2 ml. (1/2 teaspoon) of solution for each one percent of body area burned, multiplied by the weight of the patient in kilograms (1/2 the weight in pounds). In general, two to three quarts of this electrolyte solution will be given each 24 hours in addition to the usual 24-hour baseline requirements of two to three quarts of fluid which must also be maintained. No solid foods should be given for the first 24 to 48 hours of treatment.

If facilities and personnel permit, intravenous therapy should be used for patients placed in the Immediate

Treatment category who cannot tolerate oral fluid replacement. The same amount of solution outlined above for oral electrolyte maintenance should be administered intravenously within the first 24 hours. Half of the fluid administered intravenously should be 5% dextrose in saline or lactated Ringer's solution, if available. The remaining half should consist of some type of colloid solution, if available, preferably whole blood, plasma, or a plasma expander. During the second 24 hours the amount of electrolyte solution in excess of the normal daily requirement of two to three quarts may be reduced by one half. Ingestion of food should be initiated and actively encouraged if tolerated.

As a guide to fluid therapy and progress of the patient the urinary output is a useful indicator if catheterization of the patient is possible. For most patients, however, blood pressure determinations and physical signs of dehydration such as dry skin and tongue, fever, rapid thready pulse and vomiting must suffice. Prophylaxis against tetanus should be given to all patients receiving intensive treatment for burns as outlined in section on Open Wounds.

3. Delayed Treatment Category

In mass disaster situations very few patients can be expected to survive. These patients must all be placed in the Delayed Treatment category. Some patients with less than 40% body area burns must also be placed in the Delayed Treatment category if other serious injuries are present. Treatment for patients in the Delayed Treatment category should be the alleviation of pain with appropriate narcotics, analgesics or hypnotics. They should also be given oral electrolyte solution, prophylactic tetracycline therapy and tetanus prophylaxis. Food may be given if tolerated, but intravenous therapy will not be feasible for this group of patients. Local therapy of burns should consist of placing the patient between clean sheets without specific treatment. These patients should nevertheless be observed as closely as possible and reclassified when indicated since some, by reason of error in original estimate of depth of burns or because of unusual resistance to stress, may become candidates for more vigorous therapy.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

All categories of allied health personnel may be taught to perform local cleansing and dressing of first and second degree burns. Debridement and cleansing of severe third degree burns should be performed by physicians, dentists, veterinarians, or nurses who have been trained in this procedure. Application of dressings may be carried out by all types of allied health personnel after appropriate training. They may also be of great help in instructing ambulatory burn patients in self-care before discharge, and in administering oral electrolyte and fluid therapy to patients in the Immediate and Delayed Treatment category. Intravenous therapy can be carried out by physicians, dentists, veterinarians and nurses after appropriate training.

EQUIPMENT NEEDED FOR TREATMENT OF BURNS

1. Ambulatory Treatment Category

   a. Liquid soap or detergent — 3 ounces per patient
   b. Water — 1 gallon per patient
   c. Dressings
      4 x 4 inches — 10 per patient
      8 x 8 inches — 4 per patient
      22 x 18 inches — 1 per patient
      22 x 36 inches — 1 per patient

      Gauze bandages
      4 inches and 6 inches — 1 roll of each per patient
      3-inch elastic bandage rolls — 1 roll per patient
   d. Tetracycline (250 mgm. capsules) — 28 per patient
   e. Tetracycline, parenteral (100 mgm. ampules) — 1 per patient
   f. Oral electrolyte solutions each containing 3 grams of table salt (NaCl) and 1-1/2 grams of bicarbonate of soda ($NaHCO_3$)
   g. Printed instruction sheet — 1 per patient
   h. Aspirin (0.5 gram tablets) — 12 per patient
   i. Meperidine (50 mgm. tablest) — 12 per patient.

2. Immediate Treatment Category

   a. Soap or detergent — 6 ounces per patient
   b. Water — 3 gallons per patient

c. Dressings
   4 x 4 inches — 100 per patient
   8 x 8 inches — 10 per patient
   22 x 18 inches — 10 per patient
   22 x 36 inches — 10 per patient

   Gauze bandages
   4 inches and 6 inches — 10 of each per patient

d. Tetracycline (250 mgm. capsules) — 28 per patient
e. Tetracycline, parenteral (100 mgm. ampules) — 1 per patient
f. Oral electrolyte solutions each containing 3 grams of table salt (NaCl) and 1-1/2 grams of bicarbonate of soda ($NaHCO_3$) — 7 packets per patient
g. Intravenous therapy sets — 2 per patient receiving intravenous therapy
h. Plasma expanders — 2 liters per patient receiving intravenous therapy
i. 5% dextrose in saline or lactated Ringer's solution — 5 liters per patient receiving intravenous therapy
j. Morphine sulphate 15 mgm. tablets — 10 tablets per patient in Immediate and Delayed Treatment categories
k. Sodium pentobarbital (100 mgm. capsules) — 10 per patient in Immediate and Delayed Treatment categories
l. Sodium pentobarbital, parenteral (100 mgm. ampules) — 5 per patient in Immediate and Delayed Treatment categories
m. Catheters, Foley — 1 per 2 patients in Immediate Treatment category
n. Hose with nozzle spray — 1 per 30 patients.

V. OPEN WOUNDS

DIAGNOSIS OF OPEN WOUNDS

The presence of open wounds will be obvious at the time of sorting. Many of them, however, will be complicated by the presence of other injuries such as fractures of bones or damage to internal organs. Careful examination of all patients with open wounds should be carried out to determine the presence of other complicating lesions.

SORTING OF OPEN WOUNDS

In general most patients with open wounds will be given some form of immediate treatment in either the Ambulatory or Immediate Treatment category. Some of these patients with other complicated lesions may then be transferred to the Delayed Treatment category to await definitive care for the underlying lesions when circumstances permit. All patients with uncomplicated soft tissue injuries, however, should receive treatment since the prospect of functional recovery is good for most of them.

TREATMENT OF OPEN WOUNDS

The basic objective in the treatment of open wounds is to prevent development of infection and to facilitate eventual wound healing with preservation of maximum function. This is accomplished by cleansing of the wound, debridement of devitalized tissue, control of serious hemorrhage, establishment of good drainage, and application of sterile dressings to prevent further contamination.

All wounds in these austere circumstances, except those of the face, and regardless of apparent freedom from contamination, should be dressed or packed open, and no attempt at primary closure should be made. For severe facial wounds key features may be approximated to minimize subsequent deformity. (See section on Maxillo-facial Injuries.) Small wounds without obvious contamination or hemorrhage may need nothing more than thorough cleansing and the application of a sterile or clean dressing before discharge. Deeper wounds and those obviously contaminated with foreign material should be thoroughly irrigated with soap and water or saline solution before dressing. One

tablespoon of salt in one quart of water makes a satisfactory irrigating solution. Many wounds should be extended for better drainage, or through-and-through drainage should be instituted before irrigation and dressing. Without operating-room facilities and anesthesia formal debridement of major wounds is impossible and should not be attempted. Establishment of adequate drainage and superficial excision of obviously devitalized tissue is the most that can be accomplished for most wounds in severe mass disaster circumstances.

If adequate space and equipment and sufficient numbers of trained personnel are available more formal debridement may be carried out. For this, adequate local or general anesthesia is necessary. Incision should then be made through skin and fascia for visualization of the wound depths. Usually incisions are made in the long axis of the part although Z-type incisions across flexor creases may give better exposure in some areas. Hemorrhage is controlled by ligatures. Devitalized tissue should be excised with thumb forceps and scissors. Unless it is obviously dead, all skin is preserved. Fascia may be excised freely. Accessible foreign bodies are removed. Excision of devitalized muscle is a most important part of the procedure to prevent the development of serious anaerobic infection. Visible muscle bleeds when the surface is cut. Muscle of questionable viability must be excised until it bleeds. Most viable muscle contracts when pinched but muscle which has been exposed in an open wound for several hours may not contract under these circumstances.

Large fragments of bone may be cleansed and replaced in their anatomical position. Major nerve trunks should never be sacrificed but should be allowed to retract into healthy tissue. No attempt should be made to repair divided tendons under these circumstances and they should also be allowed to retract. Divided blood vessels should be ligated. If the viability of the extremity depends on these blood vessels amputation of the guillotine type may be necessary unless an end-to-end anastomosis can be done. Blood vessel grafting will be impossible under these circumstances. Lacerations in the wall of major vessels may be closed with fine silk sutures. Exposed nerves and blood vessels should be covered if possible with muscle, fat or fascia. Copious irrigation should continue during and following debridement.

After debridement, drains should be inserted if necessary. Thoracic, abdominal and joint injuries should have the pleura, peritoneum or synovium closed.

After debridement, wounds should be covered with bulky dressings to absorb drainage. Wet dressings are not practical or desirable under these circumstances. Amputation stumps should also be left open and dressed. After dressing if the patient is to remain in the hospital it may be advisable to splint the injured part to minimize pain and as an additional deterent to wound infection. Immobilization of extremities should always be the position of function. After the initial treatment of the open wound has been carried out, some patients may be transferred to the Delayed Treatment category to await definitive therapy for other underlying injuries. All patients with open wounds, however, unless other multiple and severe injuries occur, will be given local treatment for the open wound before assignment to the Delayed Treatment category.

TETANUS PROPHYLAXIS UNDER AUSTERE CIRCUMSTANCES

All patients with open wounds or third degree burns should receive prophylaxis against tetanus. Adequate cleansing and debridement of devitalized tissue are the most important measures in the prevention of tetanus infection.

All these patients should receive 0.5 ml of fluid or alum precipitated tetanus toxoid. In previously immunized persons this will act as a booster dose and produce a prompt antibody response. In unimmunized or partially immunized individuals it may initiate an antibody response within the incubation period of the disease, and in any case, accomplishes the important purpose of starting active immunization. Persons not previously immunized should be instructed to obtain a second tetanus toxoid immunization injection one month later.

A third procedure in tetanus prophylaxis under these austere circumstances, is the use of prophylactic antibiotics in all persons with open wounds or burns. All these patients should be given oral tetracycline therapy (250 mgm. four times daily for one week). This will help prevent the development of tetanus infection as well as reduce the chance of other wound infections. Patients with open wounds in the Ambulatory Treatment category should be given a one-week

supply of tetracycline capsules together with instructions for treatment. In patients with more severe wounds in the Immediate and Delayed Treatment categories, tetracycline therapy may be continued for two weeks.

The final step in the prophylaxis of tetanus — administration of antitoxin — should be reserved for unimmunized patients in the Immediate Treatment category who have severely contaminated wounds containing necrotic tissue or foreign bodies, and in whom adequate cleansing and debridement is impossible. Either intradermal or conjunctival testing for hypersensitivity should be carried out before giving antitoxin. This is accomplished by injecting 0.1 ml. of a 1:100 dilution of antitoxin intradermally, or by instilling a drop of the same dilution into the conjunctival sac. A positive reaction indicating hypersensitivity is a development of a raised erythematous wheal at the site of injection, or the development of redness and itching of the conjunctiva within 15 to 20 minutes. If the hypersensitivity test is positive, no attempt should be made to desensitize the patient to antitoxin, but reliance should be placed upon adequate wound care, antibiotics, and tetanus toxoid. If the sensitivity test is negative, and if antitoxin is considered necessary, no less than 5,000 units of either equine or bovine tetanus antitoxin should be given, and considerably larger amounts may be necessary for severely contaminated wounds. Epinephrin and antihistamines should be available whenever antitoxin is given in the event of anaphylactic reactions.

PROPHYLAXIS OF INFECTIONS IN OPEN WOUNDS

In addition to specific prophylaxis against tetanus, the patient should be protected as far as possible against the development of other local wound infections. Under these austere circumstances prophylactic antibiotic therapy should be given to all patients with major open wounds and third degree burns whether treated on an ambulatory basis or admitted to the hospital. All patients should be given tetracycline therapy by mouth, if possible, (250 mgm. four times daily for one week). In patients unable to tolerate oral medication, parenteral therapy should be used. Patients treated on an ambulatory basis and discharged should be given a sufficient supply of antibiotic capsules for one week of therapy. After one week, antibiotic therapy may be discontinued for all patients whose wounds are healing satisfactorily.

Patients with extensive open wounds or burns should have antibiotic therapy continued until healing is well underway. If wound infection develops in these patients while on tetracycline therapy the infection should be considered resistant to this antibiotic and another broad-spectrum antibiotic substituted. (See section on Infectious Diseases.)

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Allied health personnel can carry out much of the treatment of patients with open wounds. Cleansing and dressing of all minor wounds may be carried out by all categories of allied health personnel after training without direct supervision. They may also instruct ambulatory patients in self-care including antibiotic therapy. The principles of debridement may also be taught to allied professional personnel such as dentists, veterinarians, and nurses who may then care for many uncomplicated major wounds. Major debridement including extending of excisions and diagnosis of other associated injuries should be carried out by a physician. Tetanus prophylaxis, antibiotic therapy and instruction of patients are all areas where allied health personnel may assist in the care of patients with open wounds.

EQUIPMENT AND SUPPLIES FOR THE CARE OF OPEN WOUNDS

1. Basic surgical kit — 1 per 100 patients
   (See section on Equipment and Supplies)
2. Supplemental operating room supplies
   (See section on Equipment and Supplies)
3. Dressings
   4 x 4 inches — 100 per patient
   8 x 8 inches — 10 per patient
   22 x 18 inches — 10 per patient
   22 x 36 inches — 10 per patient

   Adhesive tape, 1 inch and 4 inches — 1 roll per patient

   Gauze bandages, 4 inches and 6 inches — 10 of each per patient
4. Lidocaine, parenteral solution, 1% 25 cc. per patient
5. Tetanus toxoid, alum precipitated or fluid — 0.5 cc. per patient
6. Tetracycline capsules, 250 mgm. — 49 capsules per patient

7. Tetracycline, parenteral, 100 mgm. vials — 10 per patient
8. Equine tetanus antitoxin, 10 cc. vials — 1 per 10 patients
9. Epinephrin 1:1000, 1 cc. ampules — 1 per 10 patients
10. Diphenhydramine capsules, 50 mgm. — 1 per 2 patients.

DIAGNOSIS OF HEAD INJURIES

Head injuries are common in most disaster situations. Soft tissue injuries of face and scalp are most obvious, but intracranial injuries should be suspected in any of the following circumstances.

1. Any evidence of trauma to the head including lacerations and contusions of the scalp.
2. Unconsciousness, or a history of unconsciousness.
3. Seizures or localizing neurological symptoms.

Skull X-rays and other diagnostic aids will rarely be feasible in these circumstances, and diagnosis will have to be made on the basis of localizing neurological signs and the type of trauma.

SORTING OF PATIENTS WITH HEAD INJURIES

Patients with soft tissue injuries to the scalp without evidence of underlying brain damage may be placed in the Ambulatory Treatment category.

Patients with closed head trauma (concussion) showing no disturbance of neurologic function and who have regained consciousness may also be placed in the Ambulatory Treatment category.

Patients with open and closed head injuries who are unconscious or convulsing, or who show localizing neurological signs should be placed in the Delayed Treatment category.

Patients with head injuries who are conscious on arrival but lapse into unconsciousness following admission may be placed in the Immediate Treatment category, if possible, since these persons may have a relatively good prognosis if promptly treated. For this reason the state of consciousness should be recorded on the medical record at the time of Sorting.

TREATMENT OF PATIENTS WITH HEAD INJURIES

1. Ambulatory Treatment Category

Soft tissue injuries to the scalp without evidence of underlying brain damage may be treated on an ambulatory

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basis with cleansing and dressing of the wound. Large avulsion flaps may be loosely replaced with sutures. Tetanus prophylaxis should be carried out as outlined in the section on Open Wounds.

The Barton type of dressing is best for most open scalp wounds of any magnitude. This dressing encircles the head in the horizontal plane at the level of the forehead, and in the vertical plane at the level of the chin. In using this type of dressing, care must be taken not to interfere with breathing and swallowing.

2. Immediate Treatment Category

The only patients who will be given immediate, definitive treatment for head injuries — other than ambulatory patients with minor wounds — are the relatively small number who are conscious on arrival at the hospital, and who lapse into unconsciousness following admission. These patients may be moved into the Immediate Treatment category and burr holes made in the skull for decompression and exploration since this relatively simple procedure may alter an otherwise grave prognosis. The only other group of patients who should be given immediate, definitive hospital treatment for serious head injuries are those with open or depressed skull fractures and who have no loss of consciousness or other neurologic disturbance. Debridement, decompression and closure of the skin should be carried out for these patients as soon as possible since this may prevent subsequent infection, paralysis, seizure disorders and death.

3. Delayed Treatment Category

Patients with open or closed head injuries who are unconscious are placed in the Delayed Treatment category. Wounds should nevertheless be cleansed and dressed as soon as possible. The patient should be placed on his side or abdomen to prevent aspiration of secretions. Sedatives and narcotics should not be used in persons with head injuries unless strongly indicated by other conditions since these further depress respiration. All persons who have obvious herniation of the brain, whether conscious or not, should be placed in the Delayed Treatment category and a simple dressing applied since skin closure alone will not prevent further heriation of brain contents. Patients with

head injuries placed in the Delayed Treatment category should be given simple supportive care and observed as closely as possible since some of them may become candidates for more vigorous therapy as circumstances permit.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Care of most local soft tissue head injuries may be carried out by most categories of allied health personnel after appropriate training. Actual definitive treatment of intracranial injuries should be carried out only by physicians trained in these procedures. Supportive care of patients placed in the Delayed Treatment category including observation of state of consciousness and simple neurologic examination may be carried out by nurses and other types of allied health personnel after appropriate training.

EQUIPMENT AND SUPPLIES NEEDED FOR THE TREATMENT OF HEAD INJURIES

1. Oral airways — 1 per 10 patients
2. Tracheostomy tubes, all sizes — 1 per 10 patients
3. Disposable razors and blades — 1 per patient
4. Multilayered gauze head roll, 4 inches wide;
   4 x 4 inches multilayered surgical dressing — 12 per patient;
   Elastic bandage, 3 inches — 1 per patient
5. Caffeine sodium benzoate, 5 cc. ampules, parenteral injection — 1 per patient
6. Dilantin, oral and parenteral, 100 mgm. capsules — 10 per patient
7. Sodium pentobarbital, 0.1 gram capsules — 10 per patient
8. Sodium phenobarbital, parenteral, 100 mgm. capsules — 10 per patient
9. Operating Room Equipment (See section on Equipment and Supplies)
   a. Basic Minor Kit
   b. Burr Hole Kit — 1 per 100 patients
   c. Craniotomy Kit plus Basic Major Kit — 1 per 100 patients
   d. Supplemental items, omitting retractors.

DIAGNOSIS OF VERTEBRAL AND SPINAL CORD INJURIES

Vertebral and spinal cord injuries should be suspected in all patients complaining of back or neck pain, and in all patients who have jumped or fallen from a height. These injuries should also be suspected when there is evidence of directed trauma to the neck or spine, and in all unconscious patients. A bilateral loss of power or sensation below the level of the suspected injury confirms the diagnosis. Unilateral neurological deficits are more likely due to nerve root or peripheral nerve injury, than to cord or verterbral injuries.

SORTING OF PATIENTS WITH VERTEBRAL AND SPINAL CORD INJURIES

Vertebral fractures may be divided into two groups, those with and those without neurological deficit. Both of these groups should be placed in the Delayed Treatment category.

MANAGEMENT OF PATIENTS WITH VERTEBRAL AND SPINAL CORD INJURIES

1. Treatment of Vertebral Fractures

First aid treatment of all suspected vertebral and spinal cord injuries consists of keeping the patient prone or supine on a firm surface. In transporting the patient this position should be maintained. He should never be lifted by the shoulders and feet. Suspected cervical spine or cord injuries are treated in the same manner with the head held in the neutral position. Patients with suspected vertebral fractures with no evidence of spinal cord injury need only bed rest on a hard surface until pain subsides sufficiently to permit ambulation and discharge. If the suspected fracture is in the cervical spine, the neck should be immobilized as much as possible to prevent spinal cord damage. This can be done by a simple halter arrangement beneath the chin and occiput with 5 to 10 pounds of vertical traction over a pulley at the head of the bed or stretcher. If these facilities cannot be arranged, the cervical spine

should be held in neutral position with an improvised cervical collar, sandbags or other heavy padded objects such as bricks or stones.

2. Treatment of Spinal Cord Injuries

Patients with vertebral fractures accompanied by spinal cord injury should also be placed in the Delayed Treatment category, since surgical treatment even under optimal conditions is usually unsuccessful. First aid consists of keeping these patients flat on a firm surface in either the prone or supine position. A pillow, rolled blanket, or other object may be placed beneath the lumbar spine if the patient is kept in the supine position to increase the lumbar curve and prevent further compression of the spinal cord and associated nerves. Most persons with spinal cord injury will develop urinary retention and require an indwelling catheter. They may also require enemas after a few days for evacuation of the paralyzed bowel. If cervical cord injury is present, treatment should be as outlined in the preceding paragraph.

FUNCTIONS OF ALLIED HEALTH PERSONNEL IN TREATMENT OF VERTEBRAL AND SPINAL CORD INJURIES

The initial diagnosis and sorting of patients with suspected vertebral and spinal cord injuries must be performed by an experienced physician. Since no active treatment will be carried out for these patients allied health personnel may carry out the supportive procedures outlined above after appropriate training. Transportation of these patients to appropriate areas within the hospital, and immobilization with, or without, traction may all be accomplished by any category of allied health personnel after appropriate training. Application of cervical traction should be supervised by a physician but may be carried out by persons in allied health fields.

EQUIPMENT AND SUPPLIES FOR TREATMENT OF VERTEBRAL OR SPINAL CORD INJURIES

1. Beds or stretchers — 1 per patient
2. Sandbags or similar heavy padded objects — 2 per patient

3. Cervical halter, cord, and weight bag — 1 per patient
4. Plywood, 3/4-inch, or similar hard material for bedboards and for placing under patients on stretchers — 1 per patient
5. Weights, 2-pound — 5 per patient
6. Meperidine, 50 mg. tablets — 50 per patient
7. Gantrisin, 0.5 gm. tablets — 40 per patient
8. Foley catheters, sizes 10-24 — 1 per 10 patients.

DIAGNOSIS OF THORACIC INJURIES

Chest wall and intrathoracic injuries may frequently be missed at the time of sorting, particularly in the unconscious patient or the patient who is in shock. All clothing should be removed from these patients and a complete examination performed at the time of sorting.

Intrathoracic injuries should be suspected with all rib fractures, multiple injuries, and in all penetrating wounds of the abdomen and neck, and thorax, even though the wound of entry may be a considerable distance from the chest. More obvious penetrating and blunt injuries to the thoracic wall will be diagnosed by direct examination of the chest wall.

1. Hemothorax and Pneumothorax

The diagnosis of intrathoracic injuries, particularly hemothorax and pneumothorax requires careful auscultation and percussion of the chest. The physical signs of hemothorax are absent breath sounds and dullness to percussion over the lower posterior or entire chest wall, depending on the extent of the hemothorax. With pneumothorax there are decreased or absent breath sounds, and hyperresonance to percussion over the upper, and perhaps entire chest wall depending on the extent of the pneumothorax. There may also be diminished chest wall excursions and retraction of the interspaces with respiration. There may be a shift of mediastinum to the opposite side of the chest if the hemothorax or pneumothorax is under tension. If the diagnosis is not certain by physical signs, a medium gauge needle inserted through the second anterior interspace with aspiration of air in the case of pneumothorax or into the eighth or ninth posterior interspace with the aspiration of blood in the case of hemothorax, will confirm the diagnosis. It is unlikely that X-ray will be feasible diagnostic aid under these circumstances.

2. Crush Injuries of the Chest Wall

Paradoxical breathing is the retraction instead of expansion of a portion of the chest wall on inspiration, and

the expansion instead of retraction upon expiration. This type of breathing occurs with crush injuries or direct blows to the chest where there are multiple rib fractures in which the fractures are comminuted and the anterior and posterior aspect of the same ribs are broken.

SORTING OF THORACIC INJURIES

Patients with simple rib fractures with no evidence of respiratory embarrassment or intrathoracic injury may be placed in the Ambulatory Treatment category. Patients with all other types of thoracic injuries including penetrating wounds, multiple rib fractures with signs of respiratory embarrassment, hemothorax and pneumothorax should be placed in the Immediate Treatment category since relatively simple procedures as outlined below may save many of them. After initial emergency treatment some of these patients may be transferred to the Delayed Treatment category to await further definitive care.

TREATMENT OF THORACIC INJURIES

1. Simple Rib Fractures

Patients in the Ambulatory Treatment category with simple rib fractures need not be treated at all but can be made more comfortable by wrapping the chest with an Ace bandage. Analgesics or narcotics may also be prescribed if needed. Intercostal nerve block is time consuming and the effect is of short duration and is not recommended under these circumstances.

2. Multiple Rib Fractures with Respiratory Embarrassment Due to Instability of the Chest Wall

These patients when first seen may be in respiratory distress because of instability of the chest wall and/or splinting of the injured parts. Such patients should be placed in the Immediate Treatment category and immediate tracheostomy done if other injuries are not present which would place them in the Delayed Treatment category. If there is any delay in the performance of the tracheostomy at the time of diagnosis, and sorting, patients may require ventilatory assistance by means of positive pressure oxygen, if available, or mouth-to-mouth ventilation, either direct or with an S-shaped airway or other device. By direct

laryngoscopy an endotracheal airway may also be rapidly inserted and positive-pressure oxygen or mouth-to-tube resuscitation given. Stabilization of the chest may occasionally be accomplished by placing sand bags or other heavy padded objects along the lateral chest wall with the patient in the supine position. This procedure combined with tracheostomy may provide enough ventilatory reserve to maintain life. If the patient is still in respiratory distress following these maneuvers, respiratory exchange may be helped by one or both of the following methods.

First, the chest wall may be stabilized by overhead or lateral traction. This may be done quickly by passing steel wires on a curved needle, or placing towel clips around one or more of the involved ribs. Traction is then applied. Overhead traction requires some sort of a frame or overhead pully arrangement over which a rope can be passed and a weight attached to the distal end to provide traction. Lateral traction is somewhat easier to improvise, but also requires pulleys attached to some sort of an outrigger.

Second, respiratory exchange can be maintained by intermittent positive-pressure oxygen. This can be done manually or with respirators of any type, but it is unlikely that the facilities for the delivery of artificial respiration to large numbers of patients will be possible under these circumstances. If this is so, patients whose ventilatory exchange cannot be maintained by tracheostomy and stabilization of the chest wall must be placed in the Delayed Treatment category.

Proper after-care of the tracheostomy is essential for survival of patients with a tracheostomy. This consists of cleansing or replacing of the inner sleeve of the tracheostomy tube as often as is possible, and suction of secretions from the trachea if the patient is unable to do this himself. Suction may be accomplished by standard suction machines, if available, one of which can be used to serve many patients. If these are not available then suction can be obtained by a syringe, of the bulk or plunger type, and a soft rubber catheter. Humidification of room air by boiling water, if vaporizers are not available, is helpful in liquefying pulmonary secretions of patients with a tracheostomy.

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3. Penetrating Wounds of the Chest

At the time of Sorting, open wounds of the chest should be covered with an occlusive dressing of gauze and adhesive tape. This applies to all open chest wounds as it may be difficult to be sure whether an open wound penetrates the chest wall or not, since they may not all show evidence of the sucking which is characteristic of penetrating wounds.

Many of these patients may also be in respiratory distress from tension pneumothorax, hemothorax, or multiple rib fractures and will require maintenance of airway as described above under multiple rib fractures. If penetrating wounds of the chest are complicated by multiple rib fractures and instability of the chest wall, pneumothorax, or hemothorax with respiratory embarrassment, these conditions must be treated as outlined in the appropriate section before the wound itself is treated. Following stabilization of these conditions the wound should be thoroughly debrided with removal of all devitalized tissue, dirt, and loose fragments of bone. The defect in the chest wall must be closed. Large defects which cannot be closed will require the sliding or rotation of flaps of skin and subcutaneous tissue for closure. The defects left by movement of flaps should be dressed and allowed to heal by granulation or grafting at a later date. The thoracic cavity should be drained with a large bore catheter attached to an underwater seal placed well below the level of the chest.

4. Pneumothorax

Pneumothorax may occur with any penetrating wound of the chest, or with rupture of the lung or tracheobronchial tree from blunt or penetrating trauma. Traumatic pneumothorax is always accompanied by some degree of hemothorax. Minor pneumothoraces will in most instances go undiagnosed under these conditions and require no treatment other than treatment of the penetrating injury. With extensive pneumothorax however, particularly those which are under tension, there may be marked respiratory embarrassment which will require treatment immediately. The maintenance of airway has been described under multiple rib fractures. In addition, merely inserting a No. 15 needle into the second anterior interspace in the mid-clavicular line may decompress a tension pneumothorax and provide prompt

respiratory relief. Aspiration is also helpful and may be carried out by several methods.

The pneumothorax may be aspirated with a needle and syringe. In some cases this procedure coupled with correction of the cause of the pneumothorax is all that is necessary to restore adequate respiratory exchange.

In other cases a large bore needle or trocar may be passed through the second intercostal space in the midclavicular line and large calibre polyethylene tubing or a soft rubber urethral catheter may be passed through the needle or trocar and the needle or trocar withdrawn. The catheter or tubing is then secured to the chest wall with a suture or tape to avoid inadvertent removal. The end of the tubing or catheter should then be placed under several inches of clean, but not necessarily sterile, water which should be two feet or more below the level of the chest. This will prevent aspiration of water into the chest upon inspiration.

This should provide progressive relief of respiratory embarrassment as the lung expands. The tubing should be left in place until there is evidence on physical examination of full expansion of the lung, and air can no longer be aspirated from the chest. This may take several days or weeks. It must be remembered in using tubing to aspirate air from the chest that the larger the calibre of the tube, the less likely it is to become blocked with blood and serum clots, although a large bore needle, prethreaded over polyethylene tubing is faster and easier to insert than a large trocar, particularly for personnel not familiar with this procedure.

5. Hemothorax

Hemothorax may be caused either by a penetrating wound of the chest wall, or by intrathoracic trauma to the intercostal blood vessels, the lung parenchyma, or by injury to the great vessels or the heart itself. In many cases small amounts of blood in the chest will not be detectable by physical examination and under these circumstances treatment will not be necessary. Patients with hemothorax detectable by physical examination but without respiratory embarrassment or signs of shock should be placed in the Delayed Treatment category for observation. If the hemothorax progresses and signs of respiratory embarrassment

or shock become evident they may be transferred to the Immediate Treatment category and treated as outlined in the next paragraph.

Patients with hemothorax detectable by physical examination and with signs of respiratory embarrassment and shock should have the blood aspirated from the thoracic cavity as well as receive immediate treatment for shock. This can be done by insertion of a large bore (No. 18 or 15) needle into the eighth or ninth interspace in the posterior axillary line. Blood may then be aspirated into a citrated vacuum blood donor bottle which can be used to transfuse the patient. Blood should be aspirated only until signs of respiratory embarrassment are relieved. If, after aspiration the signs of respiratory embarrassment and shock recur, the procedure should be repeated. If these occur again, no further attempt should be made to aspirate the blood, hoping that a tamponade effect by the blood within the thoracic cavity may stop the bleeding. If this is not successful a thoracotomy must be performed, if the facilities, time and personnel are available, since frequently intrathoracic bleeding may be stopped by simple ligation of a vessel in the chest wall. If, however, bleeding is suspected from the heart or great vessels, thoracotomy is not indicated and the patient must be placed in the Delayed Treatment category. It is unlikely that any patients with heart or great vessel injury will survive long enough to reach a functioning hospital.

6. Empyema

It is probable that under these austere circumstances many patients will develop empyema following penetrating chest wounds or trauma to the lung. This complication may have occurred by the time they reach a functioning hospital. Fever, physical signs of dullness, decreased or absent breath sounds, purulent drainage from an open wound or aspiration of pus will confirm the diagnosis. If thin pus is encountered upon aspiration, as much as possible should be withdrawn with a large bore needle and syringe. Following this a trocar should be inserted into the appropriate interspace, and a soft rubber catheter or tube with multiple holes for drainage passed through it and the trocar withdrawn. The tube is then fixed to the chest wall and attached to underwater drainage with the water seal at least two feet

below the level of the chest. A disposable Snyder hemovac suction apparatus may be used to obtain negative pressure if regular suction devices are not available. These patients may then be placed in the Delayed Treatment category. Treatment for them will consist mainly of assuring the patency of the drainage tube, and the administration of tetracycline, 250 milligrams four times a day.

If thick foul pus is obtained on aspiration indicating a walled-off empyema cavity, the patient should be placed in the Immediate Treatment category. The empyema cavity may be converted to open drainage by removal of a three- or four-inch segment of rib and insertion of soft rubber drains. If thin pus is obtained this procedure should not be done until a week or two has elapsed following closed drainage so that the surrounding lung may adhere to the chest wall preventing massive pneumothorax and spread of contamination when open drainage is instituted.

7. Antibiotic Treatment

All patients with chest injuries severe enough to require admission should be treated with tetracycline, 250 milligrams four times a day for at least seven days, or as long as fever persists.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Allied health personnel may assist physicians in carrying out all the procedures outlined above. They may apply dressings to open wounds but the more definitive treatment of most chest injuries must be carried out by trained physicians. All serious chest injuries should be seen by a sorting physician to determine the presence of underlying injuries and complications. Aspiration of the chest whether for diagnostic or therapeutic reasons should be performed only by physicians. Allied health personnel, however, may give variable assistance in maintenance of airways, suction of tracheostomies, and supervision of external drainage of chest wounds. They may also be trained to administer oxygen and observe patients in both Immediate and Delayed Treatment categories for signs of complicating conditions.

EQUIPMENT AND SUPPLIES NEEDED FOR THE TREATMENT OF THORACIC INJURIES

1. Beds or litters — 1 per patient
2. Shock blocks — 1 set per patient
3. Demerol — 8000 mgm. per patient
4. Sodium phenobarbital — 6000 mgm. per patient
5. Tetracycline, oral and parenteral — 10 gms. per patient
6. Disposable needles, hypodermic sizes
   25 x 1 inch — 5 per patient
   29 x 1-1/2 inch — 5 per patient
   18 x 2 inches — 2 per patient
   15 x 2 inches — 2 per patient

   Syringes
7. Polyethylene tubing, sizes 20, 18, and 15
8. Snyder hemovac or other simple suction apparatus — 1 per patient
9. Dressings for open wounds
   4 x 4 inches — surgical dressing — 100 per patient
   8 x 8 inches — surgical dressing — 100 per patient
   22 x 18 inches — surgical dressing — 100 per patient

   Roller bandages, 2-, 4-, 6-inch — 4 rolls per patient
10. Blankets — 2 per patient
11. Dextrose, 5%, in saline — 5 liters per patient
12. Sphygmomanometers — 1 per 100 patients
13. Procaine, 1% — 20 cc. per patient
14. Operating Room Sets (See section on Equipment and Supplies)
    a. Basic Minor Kit — 1 per 25 patients
    b. Exploratory Thoracotomy Kit — 1 per 100 patients.

IX. ABDOMINAL INJURIES

DIAGNOSIS

Severe abdominal injury, including hemorrhage and perforation of the gastrointestinal tract, can usually be recognized at the time of Sorting by the presence of pain in the abdomen or flank, and/or signs of peritoneal irritation and shock. The use of X-ray and laboratory tests in the sorting of these patients is neither feasible nor necessary.

SORTING

All abdominal injuries except superficial, nonpenetrating lacerations of the anterior abdominal wall should be placed in the Delayed Treatment category. Most abdominal injuries expected under disaster circumstances are multiple injuries and are usually associated with severe injury to other body areas, particularly the thorax and pelvis. Since these injuries are usually multiple, definitive operative therapy involves thorough exploration of the abdominal contents. This is obviously time consuming both for examination and reconstructive procedures. There are, of course, some isolated abdominal injuries such as lacerations of the liver or spleen, and solitary perforations of the gastrointestinal tract which could be treated rapidly by relatively simple procedures. All these patients must be placed in the Delayed Treatment category, however, since it is impossible to differentiate isolated injuries from multiple intra-abdominal injuries.

TREATMENT

1. Immediate Treatment Category

Treatment of patients with intra-abdominal injuries will be deferred until all other patients assigned to the Immediate Treatment category have been treated. When these patients have been cared for, patients with abdominal wounds may then be moved into the Immediate Treatment group, and laparotomy performed, if indicated. The prognosis of these patients will be impaired due to the lapse of time before definitive therapy is given. It is probable that most of those who survive abdominal injuries in a mass disaster situation will do so by localization of peritoneal

infection (abscess formation) and by fistula formation. These natural processes may be assisted by the administration of antibiotics. If the patient survives two or three days it is probable that the injury or infection has been localized and surgery is required only as indicated by this localization. In many cases only incision and drainage is necessary with proximal colostomy where indicated.

Fistulas resulting from such procedures will require definitive treatment only when facilites are available. In the meantime, the survival of patients with fistulas, particularly in the upper abdomen will be jeopardized by fluid loss, malnutrition and skin erosion. Under these circumstances, it will not be possible to measure fluid loss in most patients. These losses will have to be estimated by clinical signs of dehydration and interrogation regarding the amount of fistula drainage and urinary output. Fluid losses from fistulas should be replaced with intravenous 5% dextrose in saline solution or by 1/6M Lactate solution, if intravenous therapy is feasible. Oral electrolyte solution or oral feeding may be used if tolerated and not contraindicated by the patient's condition.

The ratio of sodium, chloride, and bicarbonate in oral and intravenous solutions should vary depending on the site of the fistula. Gastric and high intestinal fistulas require a predominance of intravenous chloride, or intravenous sodium and chloride in roughly equal amounts. Lower small bowel and colon fistulas require a predominance of sodium either by intravenous or oral route. Most gastrointestinal fistulas must be treated with 5% dextrose in physiologic sodium chloride solution intravenously since the level of the fistula will be difficult to determine except by the appearance and the relative acidity of the drainage. Gastric fistulas will show a strongly acid reaction to litmus paper whereas an alkaline reaction indicates small bowel or pancreatic drainage. Serum chemistries and contrast radiology will not be available under austere circumstances.

If the level of fistula formation can be determined by clinical or other means, 5% dextrose in saline solution is satisfactory for most upper gastrointestinal fistulas since it contains an excess of chloride. If available, potassium chloride solution, 40 meg. per liter of saline solution should be given. This will provide additional chloride as

well as potassium, both of which are lost in large amounts from high gastrointestinal fistulas.

In fistulas from the lower small bowel and proximal colon, sodium is lost in excess of chloride. Additional sodium may be supplied orally as sodium bicarbonate, 1 or 2 teaspoons in water, or intravenously as 1/6 molar (isotonic) sodium lactate in daily amounts equal to the quantity of drainage. Potassium chloride, 20 to 40 meg. per liter of saline, should also be added to replace potassium losses. Daily fluid losses (2000 to 3000 ml. per day) from urine and insensible losses should be replaced with roughly equal amounts of 5% dextrose in water and 5% dextrose in saline solution with added potassium chloride (20 meg. per liter). Large amounts of gastrointestinal drainage from any site require potassium replacement either in food, or as potassium chloride solution intravenously, (20 meg. per liter of fluid replaced).

As patients are placed in the Immediate Treatment category and subjected to laparotomy, the following surgical principles should be observed:

a. Closure of small bowel and stomach wounds.
b. Exteriorization of proximal colon wounds.
c. Closure and drainage of rectosigmoid wounds with proximal colostomy.
d. Suture and wide drainage of hepatic injuries.
e. Splenectomy for all splenic injuries.
f. Drainage of pancreatic injuries.
g. No specific therapy for renal and retroperitoneal bleeding since bleeding from these sites is usually self-limiting unless associated with retroperitoneal rupture of the duodenum or pancreas.
h. Local anesthesia whenever possible.

All patients who undergo laparotomy should receive tetracycline or other broad spectrum antibiotics intramuscularly or intravenously, and nasogastric suction. Fluid and electrolyte balance in all these patients should be restored, if possible, before surgery is attempted. This should be done intravenously.

2. Delayed Treatment Category

The treatment of shock due to intra-abdominal injury will differ from that outlined under the section on shock in

that patients with intra-abdominal injuries should not receive oral fluids unless perforation of the gastrointestinal can be ruled out. The treatment of shock for these individuals shall, therefore, consist of placing the patient in Trendelenburg position. Patients should be moved as little as possible from bed to stretcher. Normal body temperature should be preserved. Narcotics should be used intravenously for the relief of pain. Apprehension should be treated with intravenous phenobarbital. It should be remembered that individuals in profound shock may not absorb medications administered subcutaneously or intramuscularly. In general, intravenous fluid therapy will be reserved for patients in the Immediate Treatment category. Pressor agents such as nonepinephrine will serve no useful function in this group until the underlying cause of the shock has been corrected.

If abdominal contents have protruded from the abdominal cavity in any of these patients for whom an operation is not immediately possible, such contents should be returned to the abdomen and a pressure dressing placed upon the wound. This should consist of a circular dressing around the entire body to prevent further evisceration. Enterocutaneous fistulae may develop through such open wounds, if perforation of the gastrointestinal tract has also occurred. This may be immediately life saving in that it prevents generalized peritonitis but it may present problems in fluid and electrolyte balance depending on the level of perforation.

Tetracycline should be given intramuscularly, 1 gram every 24 hours, to all patients with intra-abdominal injuries regardless of treatment category. Nasogastric suction is extremely valuable in the treatment of all patients with intra-abdominal injuries if sufficient supplies and personnel are available. Any tubing of adequate caliber may be used for this purpose with suction applied by any method available. This may be done by intermittent manual suction with a syringe or by a simple, disposable spring-type suction device. Standard surgical suction machines should be reserved for patients in the Immediate Treatment category. All penetrating injuries of the abdominal wall should be treated with a pressure dressing over the wound and encircling the body.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Definitive surgical care of abdominal injuries must be carried out by trained physicians, but allied health personnel

may assist in their care in many important ways. They may assist in sorting, treating patients in shock, control of hemorrhage, and in maintenance of airway. They may also be trained to carry out debridement of superficial wounds and to apply dressings. Most patients with intra-abdominal injuries must be placed for a period of time in the Delayed Treatment category, and the supportive care given these patients may be carried out almost entirely by allied health personnel after appropriate training. Most categories of allied health personnel may be taught to carry out the treatment of shock and electrolyte therapy with only minimal supervision.

EQUIPMENT AND SUPPLIES FOR ABDOMINAL INJURIES

1. Beds or litters — 1 per patient
2. Shock blocks — 1 set per patient
3. Meperidine, 2000 mg. per patient or Morphine Sulfate, 300 mgm. per patient
4. Sodium phenobarbital, 2000 mgm. per patient
5. Tetracycline, oral and parenteral (intramuscular and intravenous) — 10 gms. per patient
6. Disposable needles, hypodermic sizes
   25 x 1 inch — 10 per patient
   20 x 1-1/2 inches — 10 per patient
   18 x 2 inches — 5 per patient
   15 x 2 inches — 2 per patient
   Syringes, 2 cc. — 5 per patient
7. Polyethylene tubing, sizes 20, 18, and 15
8. Snyder hemovac or other simple suction apparatus — 1 per patient
9. Surgical Dressings
   4 x 4 inches — 100 per patient
   8 x 8 inches — 100 per patient
   22 x 18 inches — 100 per patient
   Roller bandages, 2, 4, and 6 inches
10. Blankets — 2 per patient
11. Intravenous fluids and infusion sets
    5% Dextrose in saline solution — 10 liters per patient
    5% Dextrose in water — 10 liters per patient
    Potassium chloride, 20 ml. (20 meq.) vials — 20 vials per patient
    1/6 Molar lactate — 1 liter per patient
    Litmus paper

12. Sphygmomanometers — 1 per 10 patients
13. Procaine, 1% — 20 cc. per patient
14. Operating Room Equipment (See section on Equipment and Supplies)
    Basic Major Operating Kit — 1 per 10 patients
    Basic Major Operating Kit — 1 per 10 patients
    Supplemental Operating Kit — 1 per 10 patients.

X. PELVIC AND GENITOURINARY INJURIES

DIAGNOSIS

Pelvic injuries include simple closed pelvic fracture, open pelvic fracture, injury to the genitourinary tract with or without fracture, injuries to the pelvic colon, and retroperitoneal bleeding.

1. Closed Pelvic Fractures

Closed pelvic fractures will be difficult to recognize at the time of Sorting but should be suspected whenever multiple injuries exist, or when there is evidence of trauma to the pelvis with ecchymosis or pain on pelvic compression or weight bearing.

2. Open Pelvic Fractures

Open pelvic fractures should be suspected with any large soft tissue injuries of the pelvic area. The diagnosis can often be confirmed by examination of the depth of the wound with the gloved finger.

3. Injuries to Genitourinary Tract with or without Fracture

Patients with suspected or diagnosed pelvic fractures should be questioned for a history of bloody urine or inability to void, and the urine should be examined for gross evidence of blood. The presence of blood while highly suggestive of a rupture of the bladder or urethra is not absolute evidence. Further diagnostic work will be necessary following admission and nothing further need be done at the time to the genitourinary tract.

4. Injuries to the Pelvic Colon

These are extremely difficult to diagnose at the time of Sorting, but should be suspected in all severe fractures and penetrating wounds of the pelvis. Injuries to the rectum may be diagnosed by blood on the examining finger on rectal examination or by palpation of a laceration of the rectal wall. Injuries to the pelvic colon above the peritoneal reflection will manifest themselves as acute abdominal injury with tenderness, rigidity, and rebound tenderness. Patients with

colon injuries must be assigned to the Delayed Treatment category unless time and facilities are available for a careful exploratory laparotomy.

5. Retroperitoneal Bleeding

Retroperitoneal bleeding is a frequent complication of pelvic fractures and should be suspected in all pelvic injuries. Signs which should arouse suspicion of retroperitoneal bleeding are:

a. Presence of pelvic fracture
b. Lower abdominal tenderness
c. Absence of bowel sounds and distention of the abdomen
d. Clinical signs of shock in the presence of pelvic injuries.

SORTING OF PELVIC AND GENITOURINARY INJURIES

1. Closed Pelvic Fractures

Patients with closed pelvic fractures which are uncomplicated by genitourinary or gastrointestinal injury or shock may be placed in the Ambulatory or Delayed Treatment category. If pain or instability of the pelvis is a problem, the patients will have to be placed in the Delayed Treatment category and admitted to the hospital.

2. Open Pelvic Fractures

Patients with open pelvic fractures should be placed in the Immediate Treatment category for care of the open wounds.

3. Injuries to the Genitourinary Tract

Patients with evidence of injury to the genitourinary tract must usually be assigned to the Delayed Treatment category until personnel and facilities for diagnostic evaluation and operative repair are available. As soon as possible these patients should be transferred to the Immediate Treatment category since many of them can be salvaged.

4. Injuries to the Pelvic Colon

These patients should be placed in the Delayed Treatment category unless facilities exist for abdominal exploration.

5. Retroperitoneal Bleeding

Retroperitoneal bleeding may be confused with intra-abdominal injuries because of the presence of lower abdominal tenderness, absent bowel sounds, and shock. If there is no evidence of intra-abdominal injury other than shock these patients may be placed in the Immediate Treatment category, since many of them can be salvaged by moderate blood volume replacement.

TREATMENT OF PELVIC AND GENITOURINARY INJURIES

1. Closed Pelvic Fractures

Simple closed pelvic fractures can be treated in many cases on an ambulatory basis merely with instructions to limit weight-bearing until pain subsides. Patients with severe pain or instability of the pelvis who are unable to leave the hospital must be placed in the Delayed Treatment category and require nothing more than nursing care until they are able to ambulate outside of the hospital.

2. Open Pelvic Fractures

The open wound should be treated as outlined in the section on Open Wounds. Any gross displacement of fragments should be corrected if possible at the time of surgery. Following wound care, these patients should be treated as outlined above under Closed Pelvic Fractures. Patients with intrapelvic dislocations of the head of the femur must be placed in the Delayed Treatment category following care of the open wound.

3. Genitourinary Tract Injuries

Patients placed in the Immediate Treatment category who have blood in the urine should have further diagnositc work before treatment is instituted. An indwelling catheter should be inserted if this has not been done already. If the facilities are available, a cystogram through the catheter using 350 cc. of suitable contrast material should be performed. This will demonstrate contrast material outside of the urinary tract if extravasation has occurred. If a catheter cannot be passed, a cystogram may be obtained by performing an intravenous pyelogram and obtaining late films of the bladder.

In the presence of a severe crushing injury of the pelvis in which there is destruction of the pelvic architecture, a rectal examination must be done to determine the position of the prostate. The flank should be carefully palpated since renal injuries may manifest themselves by blood in the urine, and the diagnosis may be confirmed by the presence of a mass in the flank. If a urethral injury is small, catheterization may reveal no blood in the bladder, and the presence of the urethral catheter may be the only treatment necessary except the administration of tetracycline, 250 milligrams, four times a day. However, it is usually best in the presence of suspected injury to the urethra or the bladder to do a suprapubic cystotomy if time and facilities are available. During the performance of the cystotomy it may be possible to repair obvious tears with a two-layer closure of 2-0 chromic catgut, but undue search should not be done since it is time consuming and diversion of the urinary stream by suprapublic cystotomy is usually all that is necessary to effect healing.

If there is an avulsion of the bladder neck (which should be suspected in severe crushing injuries of the pelvis) this may sometimes be confirmed by rectal examination. In this case a Foley catheter must be inserted at the time of suprapubic cystotomy and external traction exerted on the catheter by strapping it to the inner aspect of the thigh. This will fix the neck of the bladder in its normal position. This procedure should be undertaken in all instances in which there is avulsion of the bladder neck and/or urethra. In all cases multiple drains should be inserted to the areas of urinary extravasation. If there is subcutaneous extravasation of urine about the genitalia and perineum as evidenced by subcutaneous swelling, liberal incision of the swollen area should be carried out in addition to the suprapubic cystotomy and intrapelvic drainage. If there is no evidence of rupture of the bladder or urethra but if the patient has been unable to void, the Foley catheter should be left indwelling since these patients will have urinary retention following the accident and will be unable to urinate once the catheter is removed.

Renal injuries, as manifested by blood in the urine and a mass in the flank are self-limiting in most cases. Frequently these patients develop a paralytic ileus, however, and will not be able to tolerate oral fluids. They should be

treated with intravenous fluids if unable to tolerate oral feedings. If they exhibit manifestations of shock, dextran, plasma or blood may salvage many of them. If the mass in the renal area is expanding and shock cannot be corrected by moderate blood or plasma expander therapy, these patients will have to be placed in the Delayed Treatment category, unless facilities for carrying out nephrectomy are available.

4. Injuries to the Pelvic Colon

Injuries above the peritoneal reflection should be treated by closure, exteriorization, or drainage of the area of injury and a proximal diverting colostomy, if facilities for this procedure are available and the diagnosis can be made with reasonable certainty. Injuries to the pelvic colon below the peritoneal reflection also require proximal diverting colostomy, and if pararectal or ischio-rectal abscess form, these will require drainage from the perineum. If facilities for abdominal exploration, colostomy, and drainage are not available, these patients will have to be placed in the Delayed Treatment category.

5. Retroperitoneal Hematoma

The diagnosis of retroperitoneal hematoma is extremely difficult since the symptoms may be confused with those of intra-abdominal injury. If, however, the patient has a pelvic injury and signs of clinical shock, but signs of intra-abdominal injury are minimal, then it is very likely that retroperitoneal hematoma is present. Most cases of retroperitoneal hematoma are self-limiting, but others will manifest signs of shock and can be salvaged by moderate blood volume replacement as outlined in the section on the treatment of Shock.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Allied health personnel may carry most of the responsibility for supportive treatment of patients placed in the Delayed Treatment category. Here they may carry out treatment for shock, electrolyte therapy and catheterizations when these are prescribed by the sorting physician. Some categories of allied health personnel may also be

trained to assist the physicians in the operating room in the immediate treatment of pelvic injuries.

EQUIPMENT AND SUPPLIES NEEDED FOR THE TREATMENT OF PELVIC AND GENITOURINARY INJURIES

1. Foley catheters, sizes 16-F and 24-F — 1 per patient
   Catheters, French, sizes 16-F and 24-F — 1 per patient
2. Bulk syringes — 1 per 10 patients
3. Basins, sterile, for irrigation — 1 per 10 patients
4. Rubber drains, 1/2-inch — 2 per patient
5. Dextran — 2 liters per patient
6. 5% Dextrose in saline solution — 1 liter per patient
7. 5% Dextrose in water — 2 liters per patient
8. Sterile saline solution for irrigation — 1 liter per patient
9. X-Ray machines, film, developing facilities
10. Tetracycline capsules, 250 milligrams — 10 grams per patient
    Tetracycline, parenteral — 5 grams per patient
11. Gantrisin, 0.5 gram tablets — 40 grams per patient
12. Meperidine, oral and parenteral — 2000 mgms. per patient
13. Contrast solutions for cystograms
14. Syringes, 5 and 20 cc. — 1 per 5 patients
15. Needles, hypodermic, No. 15, No. 20, No. 25 — 1 of each per patient
16. Operating Room Kits (see section on Equipment and Supplies)
    a. Basic Minor Kit — 1 per 10 patients
    b. Basic Major Kit — 1 per 100 patients
    c. Supplementary operating room supplies.

XI. EXTREMITY INJURIES

DIAGNOSIS

Most extremity injuries can be diagnosed readily by the Sorting Officer, and an X-ray is neither necessary nor feasible under austere circumstances. Suspected fractures should be sorted and treated as fractures.

SORTING

Extremity injuries often accompany injuries to other body areas so that the patient must be assigned to the Delayed Treatment category. Soft tissue injuries of the extremities including blood vessel, nerve, and tendon injuries should be treated as outlined in the section on Open Wounds. Many of these injuries, particularly of the upper extremity can be placed in the Ambulatory Treatment category, as may minor soft tissue wounds of the lower extremities. However, large soft tissue injuries of the upper or lower extremities requiring debridement should be assigned to the Immediate Treatment category. After initial care many of these patients may be transferred to the Ambulatory Treatment category, discharged and evacuated, or treated on an out-patient, buddy-care or self-care basis. All such patients discharged who require further medical attention should be given any necessary medications, their emergency medical records, and instructions in self-care or buddy-care including instructions as to when to seek further follow-up care.

Most open fractures not associated with more serious injuries should be placed in the Immediate Treatment category. Some closed fractures may be placed in the Ambulatory Treatment category.

Fractures, or suspected fractures which have not been splinted before arrival at the hospital should be splinted at the time of Sorting, regardless of the treatment category. In splinting fractures at the time of Sorting, coaptation splints using padded boards, if available, should be used whenever possible, although any rigid material will suffice. If nothing else is available, the opposite extremity in the case of lower extremity fractures, or the trunk in the case of upper extremity fractures provides effective splinting.

TREATMENT OF UPPER EXTREMITY INJURIES

Soft tissue injuries including blood vessel, nerve, and tendon injuries but not involving fractures should be treated as outlined in the section on Open Wounds.

1. Anesthesia

In suspected closed fractures and in closed fractures where there is no angulation, displacement, or other deformity demonstrable by clinical means, no anesthesia will be needed since no manipulation will be necessary.

Many closed fractures and dislocations with clinical deformity can be reduced with ease. Under austere circumstances it may not be feasible to use any anesthesia for these patients. For some, it may be possible to obtain relaxation and reduction with narcotics and barbiturates alone or with infiltration of the fracture site with local anesthesia. To obtain satisfactory anesthesia with local anesthetics it is necessary to insert the anesthetic (approximately 2 to 10 cc. depending upon the area) into the hematoma around the fracture site. If general or regional anesthesia is available, and the patient load permits, many closed reductions can be done more satisfactorily using these methods. Children, particularly, should be treated in this manner.

2. Treatment of Closed Fractures of the Upper Arm

Almost all closed upper arm fractures may be treated on an ambulatory basis unless there is associated nerve or vascular injury. Closed fractures should have obvious deformities corrected by manual traction and manipulation. This must usually be done without anesthesia or with only local anesthesia. Following gross reduction, fractures of the upper arm may be immobilized by using the trunk as a splint. This can be accomplished by a simple sling and swath holding the upper arm firmly against the chest wall with the axilla padded with any convenient soft material. Instructions must be given for active exercise of uninvolved joints, particularly the fingers, and for future medical care.

3. Closed Fractures about the Elbow Joint

Closed fractures about the elbow joint should be suspected in any injury causing swelling and pain in this area. Distal nerve and blood supply should be checked. Most of these fractures are best treated by immobilization with a

90-degree angle at the elbow either by a posterior plaster splint or by a simple sling. In this position the radial pulse should be checked. If absent, the arm should be extended beyond the 90-degree angle until the radial pulse, color, warmth and blanching on pressure returns to the hand. The patient should then be kept under observation until the stability of circulation to the extremity is assured. If adequate circulation does not return after full extension of the elbow the patient should have high priority for immediate treatment. This should consist of splitting the fascia of the antecubital space and forearm as much as is necessary to restore circulation, or, if necessary, exposing the brachial artery to relieve pressure. If the artery is injured, repair or end-to-end anastomosis may be carried out. The grafting of vascular defects will probably not be feasible under these circumstances. As X-ray and operative facilities become available, patients with elbow fractures should have a high priority for definitive therapy. Although one of the best and simplest treatments of fractures about the elbow is skeletal traction through the olecranon process, this treatment will not be feasible under austere circumstances since it immobilizes the patient and makes him less able to care for himself.

4. Closed Forearm Fractures

Forearm fractures should be immobilized in neutral position with (sugar tong) plaster splints or anterior and posterior splints made of plaster or padded material of any type. The elbow should be at right angles with the wrist in position of function (30-40° extension) and the metacarpal-phalangeal joints and fingers left free. Colles fractures can be rapidly reduced without local anesthesia and immobilized with anterior and posterior splints of plaster with the hand in volar flexion and ulnar deviation.

5. Closed Hand Injuries

Closed fractures of the hand should be immobilized in position of function with well padded volar cock-up splints of plaster or other material. Metal cock-up splints are useful in these cases. In fractures of individual digits or metacarpals only the affected digits should be immobilized in the position of function with curved metal, plaster or other material. It is important to preserve as much motion in the

remainder of the hand as possible for immediate self-care and future function.

6. Open Fractures of the Upper Arm and Forearm

Wounds of open upper extremity fractures should be treated as outlined in the section on Open Wounds. Tetanus prophylaxis should be carried out as outlined in that section. If possible, open reduction should be done at the time of debridement. Internal fixation should be used cautiously under these circumstances. Larger detached fragments of bone should be cleansed and returned to anatomical position. An attempt may be made to cover the fracture site with muscle or fascia, but the skin and subcutaneous tissue should not be closed. A dressing should be applied to the wound and the part immobilized as outlined in the section on Closed Fractures. In open fractures involving the elbow joint, in addition to debridement and reduction, the joint capsule should be closed. All other layers should be left open.

7. Open Fractures of the Hand

In open fractures of the hand, debridement should be carried out as outlined in the section on Open Wounds with local anesthesia if general anesthesia is not feasible. A tourniquet applied to the arm facilitates careful debridement. A sphygmomanometer cuff inflated to 200 to 300 millimeters of mercury provides satisfactory hemotosis if pneumatic tourniquet is not available. Extreme conservatism should be exercised in sacrificing skin, bone, tendons, or nerves. Fractured bones should be returned as accurately as possible to their anatomic positions and, if necessary, may be stabilized with Kirschner wires or wire sutures. Such fixation will have to be removed at a later date in most cases. Divided nerves should be allowed to retract into healthy tissue. No attempt should be made to repair divided tendons at the time of initial treatment. Digits whose blood supply is obviously destroyed or which otherwise are so damaged that it is futile under these circumstances to salvage them should be amputated and the stumps left open or flaps loosely approximated. Avulsed skin, if based proximally, should be loosely replaced with attached subcutaneous tissue. If distally based, avulsion flaps should be completely defatted and replaced loosely as full thickness grafts. Every attempt should be made to cover exposed tendons, nerves,

and joints if only with full thickness or split thickness skin grafts. Reduction of fractures and compression of flaps and grafts should be maintained by elevating the hand in the position of function in a bulky compression dressing. The position of function is a 30-45° extension of the wrist and 45° flexion of the metacarpal-phalangeal and interphalangeal joints. The tips of the fingers should be left free of the dressing, if possible, to observe motion and color. Only involved digits should be immobilized.

8. Infection

All patients with open wounds should receive prophylaxis against tetanus and at least one week of antibiotic therapy to prevent infection. For details see the section on Open Wounds.

TREATMENT OF LOWER EXTREMITY INJURIES

Injuries of the lower extremities, including blood vessel, nerve, and tendon injuries, but not involving fractures should be treated on an ambulatory basis unless they have other conditions requiring hospitalization. The most important objective in the treatment of lower extremity fractures is restoration of weight bearing. This is best achieved by obtaining proper alignment followed by healing. Most fractures of the lower extremity may be diagnosed without the use of X-ray. All closed fractures should be reduced as accurately as possible by closed methods under X-ray control if available.

1. Closed Fractures of the Hip and Femur

Patients with closed fractures of the hip and femur should be placed in the Delayed Treatment category and treated with bed rest, maintenance of the extremity in neutral position with a Thomas splint, if available, or a coaptation splint consisting of a crutch or long board extending from the axilla to the foot supplemented by shorter boards medially and posteriorly. If splints are not available a pillow or other padding should be placed between the legs and the injured leg secured to the opposite leg. Fixed or balanced traction other than by means of a Thomas splint will not be possible under these circumstances. Closed fractures about the knee joint should be treated as outlined under the

appropriate bone involved, remembering that alignment and eventual weight bearing are the goals of treatment.

2. Closed Fractures of the Leg

Fractures of the tibia and ankle should be one of the highest priority groups for use of diagnostic X-ray as this becomes available. Reductions of these fractures will usually have to be done with narcotics, hypnotics, local anesthesia, or without anesthesia. Following reduction, the part should be immobilized, preferably with a posterior plaster splint extending well above the knee. If plaster is not available, a Thomas splint with traction, coaptation splints or any rigid material should be used. All rigid splints should be carefully padded to prevent pressure necrosis of the underlying skin, particularly over bony prominences. Splints may be held in place with any form of wrapping. This should preferably be elastic to allow for subsequent swelling. All fractures of the tibia and ankle, whether immobilized by plaster or by splints and wrappings should be kept under observation until the danger of vascular or nerve impairment from swelling and compression is over. After the danger of swelling is past, many of these fractures can be treated on an ambulatory basis with splints or with a circular cast and crutches. In some cases a walking cast will be feasible. If no materials are available for splinting, then the other extremity, if intact, may be used as a splint, with padding between the extremities. For ambulation in a walking cast with weight bearing the knee should always be fully extended; if weight bearing is not planned the knee should be slightly flexed. In some instances, the ankles should be immobilized in the position of function, i.e., slight plantar flexion and neutral version.

3. Foot Fractures

Simple closed fractures of the foot need no treatment other than limitation of weight bearing and compression to prevent swelling. Fracture dislocations of the ankle and foot can be rapidly reduced by traction without anesthesia, and can be immobilized in a bulky compression dressing and a posterior plaster splint until swelling subsides, when a circular walking cast may be applied.

4. Open Fractures of the Leg

Open wounds of the lower extremity other than fractures should be treated as outlined in the section on Open Wounds. Patients with open fractures of the lower extremity, unlike closed fractures, should be placed in the Immediate Treatment category. If possible, reduction should be done at the time of debridement. Internal fixation should be used only when alignment cannot be maintained by immobilization. Larger detached fragments of bone should be cleansed and returned to anatomical position. An attempt may be made to cover the fracture site with muscle or fascia, but the skin and subcutaneous tissue should not be closed. A dressing should be applied to the wound and the part immobilized as outlined above under Closed Fractures. In open fractures involving a joint, the joint capsule should be closed. All other layers should be left open. Following debridement, the extremity should be immobilized in plaster, Thomas, or coaptation splints as discussed under the appropriate type of closed fracture. Circular plaster should not be used in the early management of these patients. An opening should be made over the wound at the time of subsequent dressing without removing the splints. After debridement of the wound, and attempted reduction and splinting, these patients may be placed in either the Ambulatory or Delayed Treatment category. Any patient treated on an ambulatory basis should be instructed in self-care or buddy-care and told at what interval it will be necessary for him to again seek medical attention. This information should be recorded on the Emergency Medical Tag which will accompany the patient. He should be warned of the symptoms and signs of any common complications and instructed to seek medical attention earlier if these occur.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Allied health personnel, after appropriate training, may assist in all phases of treatment of extremity injuries. They may assist in sorting, control of hemorrhage, dressing of wounds and splinting of fractures. They may also assist physicians with both open and closed reductions of fractures as well as debridement.

EQUIPMENT AND SUPPLIES FOR TREATMENT OF EXTREMITY INJURIES

1. Upper Extremity Fractures
   a. Arm slings — 1 per patient
   b. Padded wooden splints, 2 inches x 15 inches — 18 sheets per patient
   c. Sheet wadding, 4-inch roll — 1 roll per patient
   d. Surgical dressing:
      4 x 4 inches —12 per patient
      8 x 14 inches — 4 per patient
   e. Elastic bandages, 4 inches — 2 per patient
   f. Adhesive tape, 1 inch — 1 roll per patient
2. Hand Injuries
   a. Arm slings — 1 per patient
   b. Cock-up splints, metal — 1 per patient
   c. Surgical dressing:
      4 x 4 inches —12 per patient
      8 x 14 inches — 4 per patient
   d. Aluminum-foam rubber finger splints, 3/4 inch x 17 inches — 1 per patient
   e. Adhesive tape, 1 inch — 1 roll per patient
3. Upper Leg Injuries
   a. Plywood boards, padded, 6 feet x 4 inches x 1/2 inch — 2 per patient
   b. Crutches — 2 per patient
   c. Plywood boards, padded, 3 feet x 3 inches x 1/4 inch — 4 per patient
   d. Thomas splints, full and half ring — 1 per patient
   e. Elastic bandages:
      3 inches — 3 per patient
      6 inches — 3 per patient
   f. Surgical dressing:
      4 x 4 inches —12 per patient
      8 x 14 inches — 6 per patient
   g. Adhesive tape, 1 inch — 1 roll per patient
4. Lower Leg and Foot Injuries
   a. Padded plywood boards, 3 feet x 3 inches x 1/4 inch — 4 per patient
   b. Plaster splints, 5 feet x 30 inches — 24 sheets per patient

c. Cotton wadding, 6 inches — 3 rolls per patient
d. Adhesive tape, 1 inch — 1 roll per patient

5. General Equipment and Supplies

a. Cast cutters, manual or electric
b. Heavy bandage scissors, cast spreaders
c. Large scalpel handle — 1 per 100 patients
d. Scalpel blades, No. 20 — 1 per patient

6. Operating Room Equipment
(See section on Equipment and Supplies)

a. Basic Bone Kit:
1 per 2 surgeons
1 per 10 patients
b. Basic Minor Kit:
1 per 2 surgeons
1 per 10 patients
c. Supplemental items — 1 per 50 patients.

DIAGNOSIS OF MAXILLOFACIAL INJURIES

The diagnosis of open maxillofacial injuries will be obvious at the time of sorting, but the diagnosis of underlying fractures or closed maxillofacial fractures must be suspected whenever there has been direct trauma to the face or when facial contusions are present. Epistaxis is frequently associated with fractures of the nose, and malocclusion of the teeth is frequently associated with fractures of the mandible or maxilla.

SORTING OF MAXILLOFACIAL INJURIES

1. Ambulatory Treatment Category

Patients with minor lacerations without severe underlying fractures or airway obstruction may be placed in the Ambulatory Treatment category.

2. Immediate Treatment Category

Patients with severe open facial wounds, with or without underlying fractures, should be placed in the Immediate Treatment category.

3. Delayed Treatment Category

Patients with severe facial fractures without extensive soft tissue damage, hemorrhage or airway obstruction should be admitted to the hospital and placed in the Delayed Treatment category for observation. If these injuries later cause respiratory embarrassment it will be necessary to reclassify the patient into the Immediate Treatment category.

TREATMENT OF MAXILLOFACIAL INJURIES

1. Ambulatory Treatment Category

Patients with minor lacerations of the face without severe underlying fractures may be treated on an ambulatory basis. The wounds should be thoroughly cleansed and a dressing applied. Primary closure should not be carried out, but avulsion flaps may be loosely replaced and key features approximated. Tetanus prophylaxis should be carried out as outlined in the section on Open Wounds. Tetracycline, 250 mg.

four times a day should be given for one week. Through and through lacerations into the mouth should have the mucosal defect only sutured to prevent fistula formation. Lacerations involving the mucosa of the mouth but not the skin should be left open for drainage if small, or loosely approximated if large. The patient should be given instructions for self-care or buddy-care, and told if, and when, he should again need medical attention. After care will consist of changing of dressings every day or two, if possible, and gentle cleansing of the wounds with soap and water. Lacerations of the mucosa of the mouth should be rinsed with clean water or saline as often as possible, particularly after eating.

2. Immediate Treatment Category

Patients with severe open maxillofacial wounds should be placed in the Immediate Treatment category and may require first aid treatment at the time of sorting for control of hemorrhage and maintenance of the airway. Bleeding can usually be controlled by direct pressure on the bleeding point and maintained by a Barton type of dressing which encircles the head in the horizontal plane and the face in the vertical plane. This type of dressing should not be used if the airway is not secure, as it contributes to respiratory as it contributes to respiratory embarrassment. The airway can often be maintained by any of the following methods:

a. Placing the patient in the prone position
b. Inserting an oral airway
c. Pulling and holding the tongue forward
d. Inserting an endotrachial tube, if necessary, through the nose
e. Tracheostomy

Facial wounds should be thoroughly cleansed with soap and water and saline solution. Under local anesthesia or general anesthesia through an endotrachial or tracheostomy tube, all foreign bodies and detached tissue should be removed. An attempt can be made to reduce displaced open facial fractures at this time. Extreme conservatism should be exercised in excising facial skin and muscle of questionable viability. In general, only detached tissue should be removed.

After copious irrigation, key features such as the nasolabial fold, eyelids, vermillion border of the lip, helix

of the ear, etc., should be approximated with sutures. A few well placed sutures, leaving the rest of the wound open will minimize resultant deformity and permit adequate drainage. Mucosal lacerations should be handled as outlined above.

3. Treatment of Maxillofacial Fractures

Fractures of the nose are the most common type of facial fracture. Fractures with little or no displacement can only be suspected and can be treated on an ambulatory basis with no special treatment. Nose fractures with displacement can also be treated on an ambulatory basis and grossly reduced with the aid of narcotics and/or local anesthesia. Reduction can be maintained and the nose protected by a malleable nose splint or a splint made from plaster of Paris and taped to the face. If necessary the nostrils can be packed with 1/4 inch or 1/2 inch vaseline gauze to maintain reduction and stop bleeding. Fractures of the mandible are the next common type of facial fracture. If not displaced these fractures can only be suspected and require no special treatment. Displaced mandibular fractures should be suspected if there is malocclusion of the teeth following trauma to the jaw. If this is present an attempt at closed reduction can be made and the teeth placed in proper occlusion.

Since wiring of the teeth will not be feasible under austere circumstances, reduction can be maintained by a Barton type of bandage if it does not interfere with the airway. With this type of treatment only liquid feedings through a straw or nasogastric tube are feasible. Fractures of the zygoma and maxilla should be suspected if there is depression of the cheekbone area or malocclusion of the teeth. Most facial fractures will be complicated by open wounds which will require treatment as outlined in the previous paragraphs. Gross reduction without internal fixation can be attempted at the time of the wound cleansing if displacement is severe.

All facial fractures which cause problems with maintenance of airway should be placed in the Immediate Treatment category and a tracheostomy performed if the airway cannot be otherwise maintained.

All patients with significant open maxillofacial lacerations should receive prophylactic tetracycline therapy for one week. If the injury prevents swallowing, the antibiotic

should be administered parenterally, 100 mg. intramuscularly, three times daily. Prophylactic antibiotic therapy should also be given to all patients with suspected maxillofacial fractures when there is any possibility of the fracture extending into the buccal cavity. Tetanus prophylaxis as outlined in the section on Open Wounds should also be given to all patients with maxillofacial injuries.

FUNCTIONS OF ALLIED HEALTH PERSONNEL IN TREATMENT OF MAXILLOFACIAL INJURIES

All definitive treatment of maxillofacial injuries should be carried out by trained physicians. However, allied health personnel may, after appropriate training, assist the physician in rendering treatment and carrying out some procedures under his direction. Simple lacerations may be cared for directly by allied health personnel as outlined in the section on Open Wounds. Tetanus prophylaxis and antibiotic therapy can be carried out by most categories of allied health personnel after instruction. Patients with tracheostomies or severe injuries placed in the Delayed Treatment category will need close supervision which may be given by nurses and other allied health personnel.

EQUIPMENT AND SUPPLIES FOR TREATMENT OF MAXILLOFACIAL INJURIES

1. Surgical dressings:
   a. 4 x 4 inches — 24 per patient
   b. 8 x 8 inches — 12 per patient
2. Roller bandages, 4 inches — 2 rolls per patient
3. Elastic bandages — 2 per patient
4. Oral airways, assorted sizes, including children's sizes — 1 per 5 patients
5. Endotracheal tubes with inflatable cuff, assorted sizes, including children's sizes — 1 per 10 patients
6. Tracheostomy tubes, assorted sizes, including children's sizes — 1 per 10 patients
7. Nasogastric tubes — 1 per 10 patients
8. Saline for irrigation — 1 liter per patient
9. Operating Room Equipment
   (See section on Operating Room Equipment)
   a. Basic Minor Kit — 1 per 10 patients
   b. Supplemental items — 1 set per 10 patients

10. Tetanus toxoid alum precipitated or fluid — 0.5 ml. per patient
11. Tetracycline capsules, 250 mgms. — 28 per patient
12. Tetracycline, parenteral, 100 mg. dose — 2800 mgm. per patient.

DIAGNOSIS AND GENERAL PRINCIPLES IN CARE OF EYE INJURIES

The aim of treatment of eye injuries in time of mass disaster is to make an individual ambulatory and self sufficient, and to save his vision, if possible. The entire underlying theme of all eye care by non-skilled personnel is conservatism. A general rule is to refrain from interference in any injury of the eye that is not clearly minor. Eye surgery is so highly technical that it should be attempted only by fully trained personnel. In many cases the diagnosis, and in all cases, the decision of when to enucleate a damaged eye should be deferred until an ophthalmologist can see the patient. Few eye injuries demand immediate enucleation and, appearance to the contrary, some vision may be salvaged in many severely damaged eyes. Conversely, ill-advised, ill-timed or improper treatment can irreversibly worsen a relatively minor condition.

SORTING OF EYE INJURIES

At the time of Sorting some effort must be made to ascertain the extent of the eye injury. The globe may be gently inspected without undue pressure on the eyelids in an effort to open them. If the lids are swollen, they should be retracted by a vein or lid retractor under 1 percent or 1/2 percent procaine anesthesia, and the globe then inspected.

1. Ambulatory Treatment Category

Patients with minor lid abrasion, ecchymoses, and superficial skin and globe burns, wounds or foreign bodies should be placed in the Ambulatory Treatment category. First aid at the time of Sorting consists of copious irrigation with water or saline, and manual removal of any remaining superficial debris under local anesthesia if necessary. Attempts should not be made to remove deeply imbedded particles at the time of Sorting if they cannot be removed after a few attempts with a cotton applicator.

2. Immediate Treatment Category

Only minimal treatment will be given unless an opthalmologist is available. After receiving the supportive treatment

outlined below the patient will be transferred to either the Ambulatory or Delayed Treatment category to await definitive therapy.

3. Delayed Treatment Category

Patients with deeply situated but non-penetrating corneal foreign bodies should be placed in the Delayed Treatment category with local antibiotic ointment and a patch while awaiting care. Any patient with globe penetration as evidenced by extruding or contained visible foreign body, wounds extending into the globe, or a gross distortion of the normal appearance of the eye ball should be placed in the Delayed Treatment category until the time, facilities, and personnel for ophthalmologic surgery are available. A gross estimation of visual acuity should be attempted and recorded as some patients may have severe damage without external signs. First aid again consists of antibiotic ointment and a patch.

TREATMENT OF EYE INJURIES

In all cases, tetanus prophylaxis should be carried out as outlined in the section on Open Wounds.

1. Minor Injuries

Minor lacerations, superficial skin and globe burns and easily removed foreign bodies may be treated on an ambulatory basis. Lid lacerations should be loosely approximated. Globe burns should be thoroughly irrigated and antibiotic ointment applied. A patch should be placed on the eye, and the patient given instructions regarding further care.

2. Penetrating Foreign Body

If the foreign body is no longer present patch the eye and administer tetracycline, 250 milligrams, 4 times a day for seven days, evacuate or hospitalize pending ophthalmologic treatment. If the penetrating foreign body is still present in the wound and is not so large as to prevent lid closure, it is best left in place until the patient can be seen by an ophthalmologist can evaluate the eye status. Soft tissue wounds should be cleansed and loosely approximated and an eye patch applied. Oral tetracycline should be given, 250 mgm., 4 times a day.

4. Orbital Fractures

Orbital fractures may involve only the margins by direct blows, or the posterior orbit as part of a more extensive skull fracture, or both. Tissue crepitus with emphysema of the lids indicates a fracture into a paranasal sinus. Local margin fractures are usually not incapacitating and ordinarily constitute no threat to sight, but they may produce dysfunction by causing diplopia. These patients may be treated on an ambulatory or delayed basis with antibiotic therapy.

5. Thermal Burns

The skin burns are handled as described in the section on Burns. Edema of the eye lids is usually so severe that the lids cannot be voluntarily opened. Local anesthesia may be instilled between the lids and examination may be done by opening the lids with small retractors. The eyeball status must be determined as often damage will be found that otherwise would go undetected and untreated with possible permanent damage. Treatment consists of irrigation, antibiotic ointment and a patch.

6. Chemical Burns

These patients should be treated with copious irrigation of the eye with water or saline solution, instillation of antibiotic or anesthetic ointment as required, and patching of the eye.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Since no definitive therapy of eye injuries will be carried out by other than ophthalmologists, all types of emergency and supportive treatment given to these patients may be carried out after appropriate training by many categories of allied health personnel. Treatment of open wounds, application of dressings, irrigation of eyes, and instillation of local ointments may all be taught to allied health personnel. Antibiotic therapy and tetanus prophylaxis may also be carried out by many categories of allied health personnel after appropriate training.

EQUIPMENT AND SUPPLIES FOR THE TREATMENT OF EYE INJURIES

1. Local anesthetic ointment, 1% procaine — 5 cc. per patient
   Lidocaine ophthalmic ointment, 2-ounce tubes — 1 per patient
2. Antibiotic ophthalmic ointment, tetracycline ointment— 1 two-ounce tube per patient
3. Water or saline for irrigation — 1 liter per patient
4. Eye patches — 5 per patient
5. Cotton applicators — 1 per patient
6. Operating Room Equipment
   (See section on Equipment and Supplies)

XIV. OBSTETRIC PROBLEMS

SORTING

As soon as possible after a mass disaster Sorting should be carried out for all patients occupying hospital beds so that as many as possible may be discharged to provide beds for casualty victims. Probably 90 percent of the patients occupying obstetric and gynecologic beds could be safely discharged.

Most gynecology procedures are elective and except for the few exceptions listed below all gynecologic operations could be suspended for the duration of the emergency. No obstetric patients would be admitted for normal uncomplicated deliveries. Obstetrical admissions would of necessity be limited to complications of labor such as hemorrhage, abnormal presentation and cephalo-pelvic disproportion. All women with these or other complications of pregnancy would be placed in the Immediate Treatment category, since in most cases relatively simple treatment procedures may restore the patient to productive activity.

TREATMENT

1. Ambulatory Treatment Category

In times of mass disaster no patients in normal labor can be admitted for delivery, and only those patients already in the hospital should be allowed to remain whose delivery is imminent within a few hours. Normal deliveries will therefore have to be carried out in homes or shelters, etc. Since physicians will not be available for these patients, delivery must be supervised by lay persons who have received some training in normal childbirth. For this reason education of large numbers of persons in the conduct of normal delivery should be undertaken well in advance of possible emergency situations. It is a mistaken belief that women who have produced children have any knowledge of the mechanics of labor and delivery. Simple instructions in normal delivery should be given to as many people as possible. Simple training courses could be given to such groups as senior high school girls, P. T. A. members and husbands of pregnant women. Other lay groups who are normally given some instruction in childbirth, such as police and firemen would be busy with

other functions in times of mass disaster and would not be available to supervise parturition.

In addition to this mass education of individuals in the conduct of normal delivery before an actual emergency arises, more advanced courses could be offered to certain persons who may be called on to act in more difficult situations. Pregnant women should be given basic instruction in the conduct of delivery, and perhaps provided with a small kit containing two sterile plastic cord clamps, a pair of scissors and a package of six ergotrate tablets. With this advance preparation and education of large segments of the population normal deliveries could be safely conducted outside of hospitals under emergency conditions.

2. Immediate Treatment Category

Patients coming to the hospital with serious complications of labor such as hemorrhage, abnormal presentation, and cephalo-pelvic disproportion should be admitted and placed in the Immediate Treatment category. The only operative treatment for these patients would be a rapid classical Caesarian section which could be done under local anesthesia if necessary, or with minimal general anesthesia. In most caes this operation could be carried out in 15 to 20 minutes and the patient could be discharged within 48 to 72 hours after the operation.

A ruptured ectopic pregnancy is a second emergent obstetric complication requiring immediate treatment. Under these conditions, simple laparotomy with removal of the affected tube and ovary should be performed as soon as possible. Less serious pelvic bleeding from a corpus hemorrhagicum, etc., could be dealt with on an ambulatory basis with sedation and watchful waiting. Occasionally major bleeding may occur from such conditions and these should be handled the same as ectopic pregnancies. Ruptured or twisted pelvic viscera could be assigned to the Delayed Treatment category for the first 24 hours of an emergency situation but would certainly require surgery after that time. Again, a rapid gross removal of the tube and ovary of the affected side would be the procedure of choice. Less severe uterine bleeding due to gynecologic problems could be handled with ambulatory supplemental hormone therapy.

The problem of miscarriages and abortions may assume considerable proportions at the time of a mass disaster.

Since bleeding associated with incomplete abortions is sometimes massive unless the retained products of conception are removed, some of these patients must be placed in the Immediate Treatment category and given dilatation and curettage. All other patients with imminent and inevitable abortions should be placed in the Delayed Treatment category and treated with pitocin and ergotrate.

FUNCTIONS OF ALLIED HEALTH PERSONNEL

Operative care of patients with obstetric and gynecologic problems must be restricted to physicians with some experience in surgery. Normal deliveries, however, may be supervised by all categories of allied health personnel, and the training for this eventuality should be part of the preparation of all allied health personnel for expanded functions in times of mass disaster. This training could be extended beyond the usual categories of health personnel to include all pregnant women, many service groups of both men and women and perhaps even all senior high school girls.

EQUIPMENT AND SUPPLIES FOR THE TREATMENT OF OBSTETRIC PROBLEMS

1. Field delivery kit consisting of:
   a. Sterile plastic cord clamps (2)
   b. Scissors, 1 pair
   c. Ergotrate tablets (6) — 1 kit per patient
2. Pitocin
3. Operating Room Kit
   (See section on Equipment and Supplies).

XV. PSYCHIATRIC PROBLEMS

GENERAL PRINCIPLES

Some institutionalized psychiatric patients will temporarily improve under the stress of an acute disaster situation. Many patients with depression of middle age could be expected to function well during the time of the emergency and could be utilized as ancillary medical personnel within the hospital. A considerable number of schizophrenic patients could be discharged to make room for new patients. Many of the patients who are physicians and nurses with various psychopathologic conditions such as drug addiction, alcoholism and milder cases of schizophrenia could be utilized in a professional capacity immediately.

Since most state mental hospitals are located outside of the major urban target areas, they are more likely to remain intact and functioning after a thermonuclear attack, than are the larger general hospitals which are usually located in cities. Since these mental hospitals may then be the principal facilities existing to provide medical care, plans should be made for the necessary conversion of these institutions in time of emergency. Many of the patients presently in such institutions could be discharged under these austere circumstances, and many others could be utilized in the operation of a general hospital.

All patients hospitalized for psychiatric reasons could be reviewed within a few hours by one of the staff members and a decision immediately made as to disposition (discharge, utilization within hospital confines or confined without specific duties). Those patients who would need continued confinement in a mental institution could be redistributed in order to allow space for new patients.

Many of the psychiatric hospitals might well open their facilities to emergency medical and surgical cases with their regular professional staff, selected patients, and physicians and nurses from the community caring for newly admitted non-psychiatric cases. This would depend, of course, upon the needs of the community and the actual facilities of the institution. Stockpiling of the essential supplies for emergency treatment would be advisable at these institutions.

TREATMENT OF PSYCHIATRIC CASUALTIES

Psychiatric reactions to the disaster must be treated expediently since the psychiatric staff may be needed in other more emergent medical and surgical capacities. Nurses and aides under the supervision of a psychiatrist may be forced to prescribe for and treat psychiatric patients. For this purpose, without regard to diagnostic categories, the following treatment schedule is proposed for what would probably be the most common conditions:

1. Acute Anxiety Attacks— Phenobarbital 60 mgm, twice daily — Sodium Pentobarbital, 100 mgm. at bedtime.
2. Grief Reactions — Sodium pentobarbital, 100 mgm. at bedtime.
3. Panic Reactions — (Intense fear leading to disorganization with or without hallucinations, delusions, and bizarre behavior.) Chlorpromazine, 100 mgm. twice daily the first day, with doubling of dosage each day up to 400 mgm. twice daily, or until subsidence of acute symptoms.

All patients not physically incapacitated should be given specific duties. While allowing the individual the security of identification with the group, this would distract him from his own individual plight, and allow him to be of aid to others. The morale of the hospitalized group in time of a national disaster could be expected to be high. The hospitalized individuals could indeed be of aid in a neighboring community on various assignments involving care of the injured, laboring tasks, or administration functions.

EQUIPMENT AND SUPPLIES FOR THE TREATMENT OF PSYCHIATRIC PATIENTS

1. Sodium pentobarbital, oral and parenteral — 1000 mgm. per patient
2. Phenobarbital, oral and parenteral — 1000 mgm. per patient
3. Chlorpromazine, oral — 10,000 mgm. per patient.

Infections will occur in the following mass disaster situations:

1. Secondary infection of open wounds, burns and compound fractures, and infection in patients with granulocytopenia following exposure to radiation.
2. Epidemic disease following disruption of water supply and sewage disposal.
3. Bacterial or viral warfare.

SECONDARY INFECTION OF OPEN WOUNDS, BURNS, AND COMPOUND FRACTURES

For the first 24 to 48 hours after a disaster the principal problem in infectious disease will be the prevention of infection in grossly contaminated wounds. Over the next days to weeks, therapy of established infections will become a major problem.

1. Prevention

a. General Infections

All wounds should be cleansed with water and bland soap and thoroughly irrigated with saline solution. After debridement the wound should be covered with a clean dressing. Any patient with a compound fracture, a wound penetrating into a body cavity (skull, chest, abdomen or joint), a laceration extending deeper than subcutaneous tissue (into muscle, tendon, bone) or with third-degree burns or other destruction of skin should receive tetracycline, 250 mg. four times a day for seven days (children, 20 mg. per kg. per day). Tetracycline for intramuscular use, 100 mg. three times daily should be available for patients unable to take the drug by mouth. Every patient should be instructed to seek follow-up medical care in seven days if possible. A total of 28 (250 mg.) capsules of tetracycline will be sufficient for one week of oral therapy for one patient, and 2,100 milligrams of parenteral tetracycline will be enough to treat one patient for one week.

b. Tetanus

All residents of the United States who are not now immunized against tetanus should be given a series of injections

of alum precipitated tetanus toxoid to achieve primary immunization. At times of mass disaster all patients with open wounds or burns should be given 0.5 ml. of either fluid or alum precipitated tetanus toxoid. For previously immunized persons this will act as a booster dose to stimulate rapid antibody rise. In unimmunized persons it may give some protection within the latter part of the incubation period, and in any case will serve the important purpose of starting active immunization for the future. A second dose of tetanus toxoid should be given to previously unimmunized persons within three to four weeks.

The most important procedure in the prevention of tetanus is good wound care with adequate debridement and cleansing. If adequate debridement cannot be carried out and gross contamination remains, tetanus antitoxin may be given in addition to tetanus toxoid. If tetanus antitoxin is used, a minimum of 5000 units should be given and the dose may be increased to 10,000 or more units depending on the degree of contamination of the wound. Neither equine nor bovine tetanus antitoxin should be administered without testing for hypersensitivity by injecting 0.1 ml. of a 1:100 dilution of the material intradermally, or by instilling a drop of the same dilution in the conjunctival sac. If a positive reaction occurs after 15 to 20 minutes, no further antitoxin should be given and desensitization should not be attempted. Epinephrine and antihistamines should be available to treat anaphylactic reactions whenever tetanus antitoxin is administered. (For further details of tetanus prophylaxis, see the section on Open Wounds.)

c. Gas Gangrene

Prevention of gas gangrene will depend on adequate wound care and prophylactic antibiotic therapy as outlined under prevention of General Infections.

TREATMENT OF ESTABLISHED INFECTIONS

1. Local Superficial Infections

These will be treated by debridement of necrotic tissue, incision and drainage of pus.

2. Deep Infections

If severe infection occurs (septicemia, pneumonia, empyema, peritonitis, meningitis, severe cellulitis) therapy must be based on the probable antibiotic susceptibility

of the etiologic micro-organism. Since the infection will occur while the patient is taking tetracycline, this drug will probably be worthless in the treatment of delayed infections. The etiologic organisms in order of likelihood are listed with the appropriate drug of choice.

a. Staphylococcus (an estimated 90% of infections)

Methycillin is the drug of choice, but must be given parenterally, 1 gram intramuscularly every four hours. Chloramphenicol, 1 gram every eight hours is currently the best choice for an oral drug. However, new synthetic oral penicillins resistant to penicillinase are becoming available and, if proven effective, will probably supplant chloramphenicol for this purpose.

b. Pseudomonas Polymyxin B, 2.0 mg. per kg. per day intramuscularly in three divided doses is the drug of choice.

c. Group A Hemolytic Streptococcus

Twenty percent of these micro-organisms are tetracycline resistant. Penicillin should be used, 250 mg. phenoxymethyl-penicillin orally every six hours.

d. Tetanus

Tetanus should be treated with 200,000 units of tetanus antitoxin intravenously, 0.5 cc. alum precipitated tetanus toxoid intramuscularly, debridement, tetracycline intramuscularly 100 mg. three times daily, sedation with barbituates, tracheostomy, oxygen, intravenous fluids and electrolytes.

e. Gas Gangrene

Gas gangrene should be treated with tetracycline 250 mg. four times a day orally, and surgical excision of all infected tissues.

EPIDEMIC DISEASE FOLLOWING DISRUPTION OF WATER SUPPLY AND SEWAGE DISPOSAL

Most of these problems will arise in weeks rather than days after a disaster. Efforts for control will be mainly in the hands of environmental sanitation engineers. Some diseases like hepatitis, salmonellosis, and shigellosis will not be major problems in terms of mortality.

1. Prevention and Control by Environmental Sanitation

a. Insure purity of water. All drinking water from questionable sources should be boiled. Antiseptic tablets should be used if facilities for boiling are lacking.

b. Make community sewage disposal safe.

c. Control insect vectors.
Typhus — louse (DDT)
Plague — rat (Poison) and rat flea (DDT)
Malaria — mosquito (DDT)

2. Immunization

All residents of the United States should currently be vaccinated against small pox and tetanus. Once an epidemic occurs, protection by immunization against small pox, typhoid fever, typhus, plague, diphtheria, yellow fever, or cholera will probably not be feasible and will not give early enough protection.

3. Chemoprophylaxis and Therapy

In the event of a plague or typhus epidemic, all clinically ill members of the population should receive 250 mg. of tetracycline orally four times a day. If typhoid or paratyphoid fever occurs all symptomatic persons should be given 1 gram of chloramphenicol orally every eight hours. The use of DDT against the insect vectors is, however, the first line of defense against insect born diseases.

BIOLOGICAL WARFARE

Physical means such as masks for excluding aerosolized agents should be used if needed. Boiling of water will protect against a waterborne infection or toxin. Eradication of the insect vector with DDT will prevent spread by infected insects. The water supply should be made safe by sanitary engineers. Insect vectors should be eradicated by DDT or other insecticides.

Disabling diseases of low mortality which may be used as biologic warfare agents include psittacosis, equine encephalomyelitis, brucellosis, tularemia, influenza, variola (under low mortality because of existing immunity) bacillary dysentery, Q fever, and Rocky Mountain spotted fever. Oral tetracycline, 250 mgms. four times a day for one week may act as adequate prophylaxis for psittacosis, Q fever, tularemia, Rocky Mountain spotted fever and brucellosis,

but clinical illness may appear when the drug is stopped. Tetracycline should, nevertheless, be used in the therapy of all these diseases.

Diseases of high mortality which may be used as biologic warfare agents include anthrax, plague, typhus, glanders, cholera, and yellow fever. Oral tetracycline, 250 mgm. four times a day for one week may act as adequate prophylaxis for anthrax, typhus, plague, glanders, or cholera. It should also be used in the therapy of these diseases. If botulinus toxin is used as a biologic warfare agent the contaminated water can be boiled to inactivate the toxin. An aerosol would be a more deadly way of spread and physical measures such as masks designed for chemical and biologic protection would be of some value.

EQUIPMENT AND SUPPLIES FOR THE PREVENTION AND TREATMENT OF INFECTIONS

1. Tetracycline, 250 mg. capsules — 28 per patient
2. Tetracycline, 100 mgm. parenteral — 2100 mg. per patient
3. Tetanus toxoid, alum precipitated or fluid — 0.5 ml. per patient.
4. Tetanus antitoxin — 3000 units per patient
5. Methycillin, parenteral — 28 grams per patient
6. DDT Powder and Spray Gun
7. Masks designed for chemical and biologic protection.

XVII. GENERAL MEDICAL PROBLEMS

In addition to providing medical care for casualty victims at a time of mass disaster, hospitals must continue to provide medical care for patients with a variety of other urgent conditions. Some of these patients may already be under treatment in the hospital before the disaster occurs and others may develop emergent medical problems unrelated to the disaster situation.

SORTING

1. Ambulatory Treatment Category

Sorting will be carried out for all patients already in a hospital at the time of a mass disaster as soon as appropriate. In classifying these patients the same principles will be followed as in the Sorting of disaster victims. The potential for returning the patient to function and effectiveness must be weighed against the amount and complexity of professional care and hospital facilities required for his treatment. Whenever possible patients already in the hospital will be discharged to provide space for care of disaster victims. Some patients such as those undergoing diagnostic workup or awaiting elective surgery may be used to help care for other patients. Those not needing immediate medical treatment and not needed for the care of disaster victims should be discharged as soon as possible.

Patients coming to the hospital with emergency medical problems other than traumatic injuries should be routed through the Sorting area and assigned to the appropriate treatment category in the same manner as casualty victims. Only urgent conditions will be treated, and wherever possible this will be done on an ambulatory basis.

2. Immediate Treatment Category

The Immediate Treatment category will include some patients already in the hospital at the time of disaster, and some additional patients admitted for acute medical emergencies unrelated to the disaster situation. The same principles used in Sorting patients with traumatic injuries will be applied to patients with urgent medical problems. In each case the potential for return to function and effectiveness will be weighed against the amount and complexity of professional care required.

Some persons with clear-cut, simple, acute surgical problems such as acute appendicitis, urinary retention and incarcerated hernia may be placed in the Immediate Treatment category since full return to function may be expected following relatively simple, rapid procedures. Patients with more complicated surgical problems such as intestinal obstruction due to a malignancy or unknown causes, gastrointestinal bleeding, renal colic, etc., must be placed in the Delayed Treatment category.

3. Delayed Treatment Category

Patients whose treatment demands extensive professional time and facilities must be temporarily assigned to the Delayed Treatment category until additional personnel are available to carry out definitive therapy. Terminally ill and chronically ill patients must also be assigned to the Delayed Treatment category. Many patients with a variety of urgent medical and surgical problems may be given immediate supportive medical treatment and then assigned to the Delayed Treatment category to await definitive therapy at a more suitable time.

TREATMENT OF GENERAL MEDICAL PROBLEMS

1. Infectious Diseases

Many patients with infectious diseases may be discharged to continue oral antibiotic therapy outside the hospital. In general most patients with acute infectious diseases should be placed in the Immediate Treatment category since full return to function may be expected with relatively simple treatment. Patients with infections such as pyelonephritis, pharyngitis, etc., may be given a one-week supply of tetracycline and discharged. Patients with pneumonia may be discharged with oral tetracycline on the third day of illness. In cases where the nature of the infection is in doubt, oral tetracycline, 250 milligrams four times daily should be given for seven days. If oral medication cannot be given, tetracycline 100 milligrams intramuscularly three times daily should be used.

Most patients with tuberculosis may be discharged on ambulatory isoniazid therapy, 150 milligrams twice daily. Patients developing pneumonia who have no traumatic injuries may be assigned to either Ambulatory or Delay Treatment categories to receive oral tetracycline for one week.

Crowding of emergency living facilities will increase the prevalence of Streptococcal diseases. Treatment when indicated should consist of tetracycline, 250 milligrams four times daily for ten days. Infections of wounds, and epidemic diseases related to poor sanitation are discussed in the preceding chapter.

2. Non-Infectious Diseases

Relatively few patients with medical emergency problems will be assigned to the Immediate Treatment category since most of these conditions may be either managed on an ambulatory basis with appropriate therapy, or must be assigned to the Delayed Treatment category to await definitive care. A few medical emergencies may occur, however, for which immediate treatment may alter an otherwise grave prognosis.

a. Myocardial Infarction

This must be diagnosed on clinical grounds and the patient may be assigned to the Delayed Treatment category for observation. If signs of congestive failure are present, digitalis leaf, 0.1 gram daily may be prescribed. If the infarction is older than two weeks, these patients need not be admitted but may be give a four-week supply of digitalis with instruction for treatment, if needed. No anticoagulant therapy will be used in these circumstances and any patient already receiving this should have such treatment discontinued for the duration of the emergency situation. Patients with symptoms of mild congestive failure may also be given hydrochlorthiazide, 50 mgms. daily on an ambulatory basis.

b. Diabetes

In acute disaster situations, many patients with previously well controlled diabetes may be thrown out of balance. The added burden of fear, panic, bereavement, trauma and dietary irregularities may precipitate difficulties in even well controlled diabetics. The limitations of food supply and increase of activity may, however, tend to decrease the glycosuria of many diabetics. Since there is no simple substitute for testing for glycosuria in the control of diabetes, the patient should be given a four-week supply of urine testing tape together with a four-week supply of tolbutamide. He should also be carefully instructed in testing of his urine and adjusting his medication dosage accordingly.

In general, most patients with emergent general medical problems will be assigned to either the Ambulatory or Delayed Treatment categories. Tetracycline, 250 mgms. four times daily will be used as the drug of choice for all infectious diseases unless clear evidence exists that the infection is resistant to tetracycline or is more appropriately treated with some other antibiotic agent. In some cases patients with infectious diseases such as hepatitis may be assigned to the Delayed Treatment category and kept segregated in a hospital to minimize spread of their infection to others.

XVIII. RADIATION INJURY

GENERAL PRINCIPLES

In the immediate management of mass casualties following a nuclear explosion, radiation injury is a less important problem than treatment of trauma and thermal burns. Injury due to nuclear radiation may not be apparent for days or weeks, and many of the signs and symptoms are non-specific and may be masked by other conditions. In general, it may be said that if a patient has not vomited within the first 24 hours he has not received a serious radiation injury. Nevertheless, he may be contaminated with fall-out and should be monitored for this.

Radiation injury may come from three general sources:

1. The initial nuclear radiation from the fireball. This may be significant up to a maximum of three miles from ground zero depending upon the yield of the device.
2. The fall-out of gross contaminated particles. Fall-out occurs only when the fireball intersects the earth surface, so that a high air blast produces little fall-out.
3. The field of residual radiation induced by neutron exposure in soil in the immediate vicinity of ground zero.

Of these sources only the fall-out of gross contaminated particles is of importance in producing radiation injury in large numbers of people. If this fall-out is not visible during its fall or after settling on the surface, it is likely that there will be no acute effects due to this radiation source. However, it is likely that many severely injured patients will have been exposed to fall-out and will, therefore, be contaminated. The importance of fall-out in producing radiation damage is dependent upon the total dose the patient received, which in turn is dependent on the time the contamination occurred and its duration. Early fall-out has a high dose rate since fall-out in general loses 90 percent of its radioactivity within the first seven hours and is down to about 1/100 of its initial activity at the end of 48 hours. It may take several days for the accumulated dose of radiation from fall-out to bring exposed patients to medical facilities.

It is thus of considerable importance to determine the distance of the patient from the center of the explosion, and the amount of shielding or cover that he had been able to utilize in order to estimate the dose of radiation he received.

MONITORING FOR RADIOACTIVITY AND DECONTAMINATION PROCEDURES

If contamination by radioactive fall-out is a possibility in the disaster situation, all patients must be monitored for radioactive contamination before entering the Sorting area. Ideally this monitoring area should be outside the hospital and all patients and personnel entering the hospital should be screened with radiation counters to determine the presence of radioactive fall-out on clothing or the body. If contamination with radioactive fall-out is found, decontamination procedures should be carried out before removing the patient to the Sorting area.

The procedures to be carried out will vary depending on the status of the patient.

1. Ambulatory Patients

All clothing should be removed in such a fashion as to avoid contact of outside clothing with unexposed parts of the body. A copious warm shower should be taken using large amounts of soap and a soft brush. Particular attention should be given to scrubbing exposed areas such as the face, hands, fingernails and hair. If only limited amounts of water are available it may be necessary to confine washing to skin areas not covered by clothing. Contaminated clothing should be placed in tightly covered receptacles for future disposal. After decontamination the individual should then be remonitored for residual radioactivity before entering the Sorting area.

2. Litter Patients

These patients should be similarly undressed and washed. This is best done in a tub sink, if available. During general washing, open wounds should be sealed off with some material such as plastic film and tape.

3. Open Wounds

Open wounds should then be decontaminated by flushing with large amounts of water and debridement as necessary. If possible, shaving should be avoided and hair removed by clipping.

In decontamination procedures, it is advisable to avoid highly alkaline soaps, abrasives and organic solvents, since these may increase permeability of the skin and facilitate penetration of fall-out particles. The persons assisting decontamination procedures should be dressed in such a way as to protect themselves against contamination. Discarded contaminated clothing should be removed from the area since it could be a significant source of radiation. A supply of replacement clothing or gowns must be available. The drainage of the wash water used in decontamination should be known to avoid possible contamination of water supplies. If copious amounts of water are not available, consideration should be given to washing only those areas exposed, or to wiping and brushing as a method of decontamination.

SORTING AND TREATMENT OF RADIATION INJURIES

Since Sorting of patients depends in large part upon their priorities for treatment, it has proved practical to divide radiation exposure into three major categories.

1. Heavy Exposure (more than 600 rads)

Patients who have received a heavy exposure will have early, severe, and progressive symptoms. Nausea, malaise, vomiting, prostration, weakness, fever and diarrhea will be prominent. In general, there will be no hemorrhage, epilation or convulsions since the individual rarely survives long enough for these to develop. With very heavy doses, collapse and shock may develop within minutes of exposure. Few of these patients can survive and they must be assigned to the Delayed Treatment category. Only supportive therapy will be possible for these patients.

2. Medium Exposure (200-600 rads)

This is the most important category since it is likely that the maximum patient load and maximum possibility of effective treatment fall in this group. They, therefore, are placed in the Immediate Treatment category. Survival is possible in this group with a mortality of 25 percent to 50 percent with variation due to great degree of individual variability of response.

These patients will experience nausea, vomiting and malaise within a few hours after exposure. Symptomatic recovery to a variable degree then occurs and the patient

may be symptom free for a variable period of 7 to 14 days. After this latent period, symptoms of bone marrow depression develop with bleeding tendencies, petechiae, melena, fever and pharyngeal lesions. Agranulocytosis develops and secondary infection becomes a major problem for this group. Epilation also occurs. The leukopenia is most marked in one to four weeks post-exposure. White cell counts lower than 1000 cells/mm^3 are associated with a poor prognosis. Lymphocytes fall within hours of exposure and remain at a minimum count after a few days. Platelets also fall to a minimum by one to two weeks after exposure.

There are no specific therapeutic agents of value, but general supportive measures are desirable. Antiemetics may control nausea and vomiting. Transfusions of whole blood or platelets, although valuable, will not be feasible in time of mass disaster. Broad spectrum antibiotics should probably be avoided until secondary infection develops in order to avoid the development of resistant organisms. Good sanitation and personal hygiene are important in preventing infection in this group.

3. Light Exposure (under 200 rads)

These persons will have a few symptoms and their survival is probable. Some who receive a higher dose may have a mild transient nausea and vomiting which will clear completely by the third post-irradiation day. They may be discharged after monitoring and decontamination unless other injuries demand further treatment.

EQUIPMENT AND SUPPLIES NEEDED FOR TREATMENT OF RADIATION INJURIES

1. Radiation counters
2. Water
3. Soap
4. Hair clippers
5. Protective clothing for monitoring personnel
6. Additional clothing
7. Soft scrubbing brush
8. Tetracycline, 250 mg. capsules — 28 per patient.

In caring for mass casualties the anesthetist will be most needed for problems in controlling airway ranging from apnea, resuscitation, to paradoxical respiration and general anesthesia.

General anesthesia should be reserved for those patients in the Immediate Treatment group receiving definitive care. Open-drop ether anesthesia should be used for all general anesthesia and the technique of administering it may be taught to many categories of allied health personnel.

Endotracheal anesthesia would be reserved for those patients with unstable chests and/or intra-thoracic chest operations. This would necessitate the use of positive pressure anesthesia with ether, employing the E-M-O ether vaporizer.

One anesthetist could accomplish several inductions and supervise other personnel in maintenance anesthesia, supervising from four to six anesthesias at once.

The Ambu rescue breathing equipment would provide positive pressure for resuscitation, and the foot-pedal negative pressure apparatus would supply the needed equipment for tracheo-bronchial toilet in the operating theatre.

The anesthetist could then work in a supervisory capacity, supervising physicians, nurses, and other allied health personnel in giving maintenance anesthesia.

EQUIPMENT AND SUPPLIES FOR ANESTHESIA

1. Equipment
   a. E-M-O Vaporizers (complete)
   b. Ambu rescue breathing equipment
   c. Foot pedal — negative pressure suction
   d. Airways — oral — 1 per patient
   e. Endotracheal catheters with pilot balloons. Assorted sizes (0-36 French)
   f. Laryngoscopes (No. 3, No. 2 MacIntosh assorted blades) and batteries
   g. 14 French whistle-top catheters — 10-12 and 14
   h. Wire frames for ether masks and gauze
   i. I. V. sets — 2 per patient

j. Dextrose, 5 percent in distilled water — 2 liters per patient
k. Blood pressure cuffs, adult, children, and infant sizes — 1 per patient
l. Stethoscope — 1 per patient
m. Blood pressure mannometer — 1 per patient.

2. Drugs
a. Ether, 1/4 pound cans
b. Atropine, 0.5 mg/cc-30cc vials — 1 per 20 patients
c. Phenylephrine, 10 mg/cc-5cc vials — 1 ampule per 5 patients
d. Levophed, 0.1 base, 4cc amplues — 2 ampules per patient
e. Local — lidocaine, 2 percent — 30cc per patient
f. Pentothal, 5-gram ampules — 1 ampule per 2 patients.

BASIC MAJOR KIT

6 Sponge Forceps — 9-1/2-inch
6 Towel Clips
12 Straight Halsted Clamps
12 Small Curved Clamps
12 Kelly Clamps
6 Allis Clamps
4 Kocher Clamps — 9-1/2-inch
2 Poole's Metal Suction Cups
6 Needle Holders
1 Trocar

Retractors:
- 2 Vein
- 2 Small Dull Rakes
- 2 Small Richardson
- 2 Medium Richardson
- 2 Large Richardson
- 1 Balfour Self-Retaining with Blade

Scissors:
- 1 Straight Mayo
- 1 Curved Mayo
- 1 Metzenbaum Dissecting

Knife Handles:
- 1 No. 4
- 1 No. 3
- 1 No. 7

Forceps:
- 2 Tissue Smooth — 5-1/2-inch
- 2 Tissue with Teeth — 5-1/2-inch
- 2 Long Smooth Tissue — 10-inch
- 1 Long Tissue Forcep with Teeth — 10-inch

Miscellaneous:
- 1 Probe
- 1 Groove Director
- 2 Rubber Suction Tubing
- 1 Penrose Drain

BASIC MINOR KIT

3 Sponge Forceps — 9-1/2-inch
6 Towel Clips
6 Straight Halsted Clamps
6 Small Curved Clamps
6 Kelly Clamps
6 Curved Mosquito Clamps
2 Allis Clamps
3 Needle Holders

Retractors:
2 Vein
2 Small Dull Rakes
2 Small Richardson

Scissors:
1 Straight Mayo
1 Metzenbaum Dissecting

Knife Handles:
1 No. 4
1 No. 3

Forceps:
2 Tissue Smooth — 5-1/2-inch
2 Tissue with Teeth — 5-1/2-inch

Miscellaneous:
1 Probe
1 Groove Director
2 Suction Tubing
1 Penrose Drain
2 Suction Tips (Large, Small)

EXPLORATORY THORACOTOMY WITH RIB RESECTION

1 Basic Minor Kit
1 Alexander Periosteal Elevator
1 Rib Cutter
1 Rongeur
1 Finochietti Retractor
1 Rib Approximator (Contractor)
Chest Tubes and Connectors
Bottles

VASCULAR REPAIR KIT

1 Basic Major Kit
2 Satinsky Clamps
2 Medium Blakemore Clamps
2 Large Blakemore Clamps
2 Angled Beck Aortic Clamps
2 Vascular Smooth Fine Forceps — 7-3/4-inch
1 Pair Nerve Hooks (Small)
Braided Silk No. 4 Umbilical Tape
Assorted Bulldog Clamps

BASIC BONE KIT

1 Basic Minor Kit
1 Broad Periosteal Elevator
1 Narrow Periosteal Elevator
2 Bone Hooks
1 Rongeur
1 Bone Cutter
2 Osteotomes (Narrow and Medium)
1 Mallet
1 Ruler
1 File
1 Zimmer/Collison Drill and Key
Assorted Drill Bits
2 Large Eight-Pronged Rakes
2 Bennett Retractors
1 Amputation Knife
1 Bone Saw
1 Gigli Saw
6 Threaded Kirschner Wires

BURR HOLES KIT

1 Periosteal Elevator
2 Mastoid Self-Retaining Retractors
1 Hudson Drill
1 Perforator and Burr
2 Silver Clip Appliers and Silver Clips
1 Dural Hook
1 Ventricular Needle
1 No. 7 Knife Handle

BURR HOLES KIT — (Continued)

1 Whistle-Tip Catheter No. 8
2 Neurological Tissue Forceps (1 Fine Tooth, 1 Smooth — 7-inch)
1 10 cc. Syringe
2 Asepto Syringes (1 Ounce)
1 Bovie Pencil and Ball Tip
Assorted Cottonoid Sponges
1 Package Straight Needles (6 per Package) with 000 Silk — 18-inch Strands (Milliner No. 7)

CRANIOTOMY KIT — Plus Basic Major Kit (omit Retractors) and Burr Holes Kit

12 Straight Halsted Clamps
12 Small Curved Clamps
1 Trephine — 3/4-inch
1 Sunday Staphylorraphy Elevator (Slender 8-3/4-inch)
1 Medium Chisel
1 Mallet
2 Bone Curettes (1 Medium, 1 Small)
2 Gigli Saw Handles
2 Gigli Saw Guides
2 Gigli Saws (Stille 14-inch)
1 Collison Drill with Small Bit
2 Nerve Hooks (1 Large, 1 Small)
1 Frazier Suction Tip, Angular No. 9, Fr., 9-inch
1 Ventricular Needle

Forceps:
1 Brain Tissue Smooth — 7-inch
1 Brain Tissue with Teeth — 7-inch
1 Bayonet Tissue Smooth — 7-1/4-inch
1 Bayonet Tissue with Teeth — 7-1/4-inch
1 Brigham Tumor

Rongeurs:
1 Olivecrona
1 Double-Action — 9-inch
1 Double-Action Angular (Gooseneck) — 9-inch
1 De Vilbiss
1 Spurling-Kerrison (Up-Biting)
1 Pituitary (Cup Size — 4 mm. x 10 mm.)

CRANIOTOMY KIT – (Continued)

Retractors:
2 Cushing Scalp – 3-Prong
2 Cushing Decompression
1 Brain Spoon
1 Brain Spatula
1 Aluminum

SUPPLEMENTAL OPERATING ROOM SUPPLIES
(Packaged Separately from Basic Kits)

Antiseptic Skin Solution:
Povodone – 8 ounces per patient
Liquid Soap – 3 ounces per patient

Basins and Trays (per 100 patients):
1 Prep Cup
2 Round Monel Basins (1 Small, 1 Large)
1 Mayo Tray

Catheters and Drains:
Penrose, 5/8-inch – 3 per patient
Catheters, Whistle-Tip, Rubber, Fr. No. 8, No. 16, No. 24 – 1 per 100 patients
Malecot, No. 24 – 1 per 100 patients
Foley, No. 24 – 1 per 50 patients

Drapes and Linen Packs (as many of these items as possible should be disposable)
1. Basic Operating Room Pack:
   2 Large Gowns
   8 Surgical Towels
   1 Mayo Tray Cover
   5 Laparotomy Pads
   Wrapper – 54 x 54 inch
2. Additional Drapes Individually Packed
   Laparotomy Sheet
   Thyroid Sheet
   Lithotomy Sheet
   Large Table Cover
   Small Table Cover
   Brain Sheet

Gloves:
Sterile, disposable, surgical, sizes 6-1/2, 7, 7-1/2, 8, and 8-1/2 (1 pair of each per patient)

SUPPLEMENTAL OPERATING ROOM SUPPLIES — (Continued)

Gauze Supplies:
- Gauze Sponges, 4 x 4, 32-ply (15-45 per patient)
- Multilayered Surgical Dressings, 8 x 10 (5 per patient)
- Universal Dressings — 1 per patient
- Packing, 2-inch
- Roller Bandages, 2-inch, and 4-inch
- Sheet Wadding, 4 inches x 5 yards
- Specialist Plaster of Paris Bandages, 3 x 5 inch
- Specialist Plaster of Paris Splints, 5 x 45 inch
- Burn Dressing

Needles and Syringes:
- Suture (Needles to be sterilized with Basic Instrument Kits)
- 3 each Ferguson Needles, No. 6, No. 10, No. 16
- 2 Mayo, No. 6
- 4 Cutting (2 Large, 2 Small)
- 4 French Eye, No. 3
- 2 Silver Wire (Cannula Type)
- 2 Keith Needles, Straight Trocar Point
- Milliner Needles, prethreaded 000 Silk, 18-inch Strands (prepackaged, 6 per package)

Hypodermic Needles:
- No. 20g, No. 18g, No. 15g, No. 25g
- Spinal Puncture, No. 20g, 3-1/2-inch

Syringes:
- Leur Lok, 10 cc., 50 cc.
- Asepto, 2-ounce

Saline:
- Physiological for irrigation — 1 liter per patient

Scalpel Blades:
- Sterile, prepackaged (sizes No. 10, No. 20)

Suture:
- Silk — Precut, Sterile, Black Braided (1 of each per patient)
  - 000 — 18-inch Strands (17 per package)
  - 00 — 18-inch Strands (17 per package)
  - 5-0 — 18-inch Strands (17 per package)

SUPPLEMENTAL OPERATING ROOM SUPPLIES — (Continued)

Suture: (Continued)

Catgut — (1 of each per patient)

Plain — 000 Sterile, 54-inch
Plain — 00 Sterile, 54-inch
Chromic — 0 Sterile, 54-inch
Chromic — 00 Sterile, 54-inch

Atraumatic

Chromic — 0 General Closure
Chromic — 00

Polyethylene — Prepacked on Atraumatic Cutting Edge Needles — 0, 3-0, 5-0 (1 of each per patient)

Wire —

Stainless Steel, No. 28, No. 32
Silver Wire, No. 20.

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